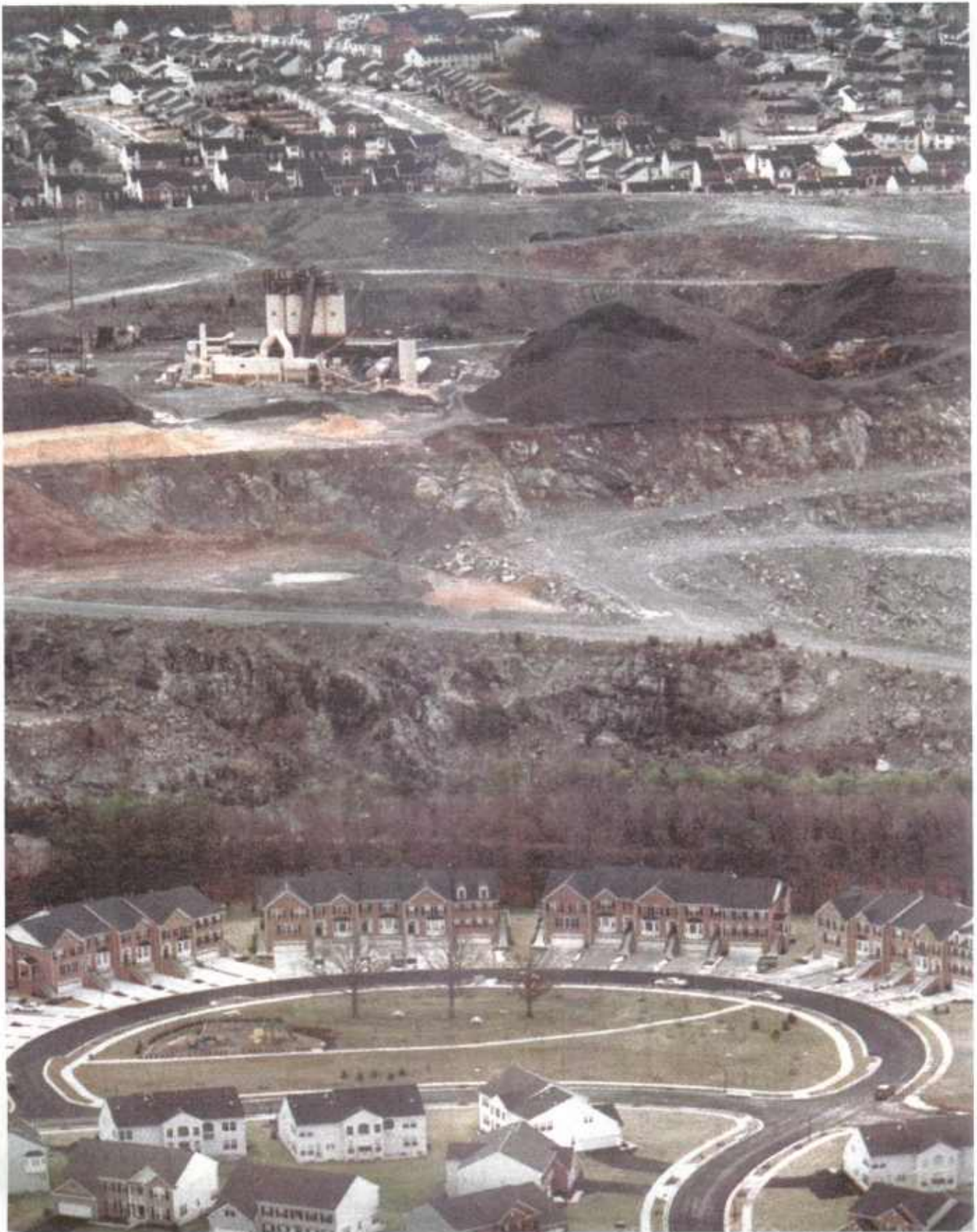


## "Environmental Noise Pollution and The Shady Grove Road Neighborhoods"



N.O.I.S.E.

Neighbors Organized to Insure a Sound-sleeping Environment

2  
N.O.I.S.E

"Neighbors Organized to Insure a Sound-sleeping  
Environment"

Dan Tuten, Coordinator

10218 Sweetwood Ave.

Rockville, MD 20850

301-762-8813

dantuten@earthlink.net

<http://www.quarryfoes.org>

## A Brief History of the Area

---

1954: First recorded license for Rockville Quarry issued

1974: Montgomery County Noise Ordinance enacted

1975: Land surrounding Quarry re-zoned as residential

~1988: Shady Grove Road designated as haul route

1991: Revised Quarry Ordinance adopted

1995-1999: The Willows of Potomac is Developed

1995/96: Rockville Crushed Stone co-develops Potomac Glen neighborhood

Aug, 1996: First home built in "southern" Willows development along SGR

May, 1999: All existing residences and lots along Shady Grove Road sold

June, 1999: Shady Grove Road paved to completion and opened to traffic

April, 2000: New asphalt plant completed; all night trucks begin running through Shady Grove Road neighborhood

June, 2000: DEP announces proposed all night quarry operation



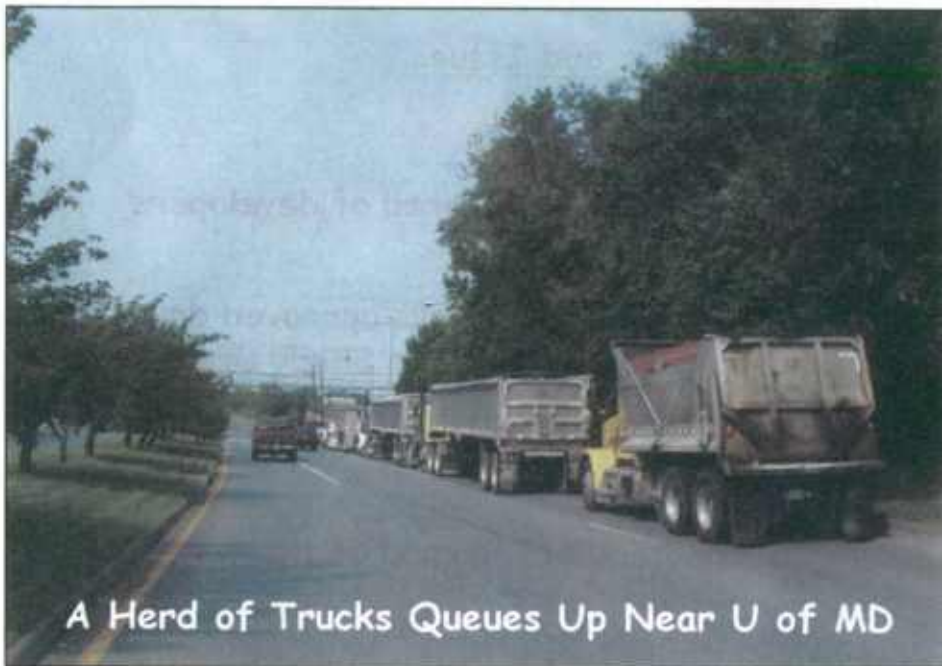


# A History of Noise Impact Reports

<u>Date of Study</u>	<u>Source</u>	<u>Conclusions and Issues</u>
Initial Study 1995 Rev. 7/24/97 (Job # 950328) Updated 4/22/99	<u>The Traffic Group</u> Used as basis for approval of Traville Project	Conclusion: No noise abatement required of developers Issues: <ul style="list-style-type: none"> <li>Failed to include <u>ANY</u> of 1,500 trucks approved daily, either as volume or as noise impact on Shady Grove Road Extension</li> </ul>
June 16, 1999	<u>Dept. of Env. Prot.</u> In response to citizen complaint of excess noise	Conclusion: No noise abatement required of the County Issues: <ul style="list-style-type: none"> <li>Shady Grove Road just opened; limited truck traffic</li> <li>Overall "average" readings 67 dBA; <u>dump truck peak readings of 85 dBA</u></li> </ul>
Sept. 13-14, 1999	<u>Polysonics Corp.</u> Basis for approval of Avalon Bay Development	Conclusion: "Limited" noise abatement required. Special construction of facing-walls will resolve all issues Issues: <ul style="list-style-type: none"> <li>Conducted on mid-section of SGR; no startup or wind-down noise is there ... until light or stop signs installed</li> <li>Understated penetration and reflected noise impact</li> </ul>

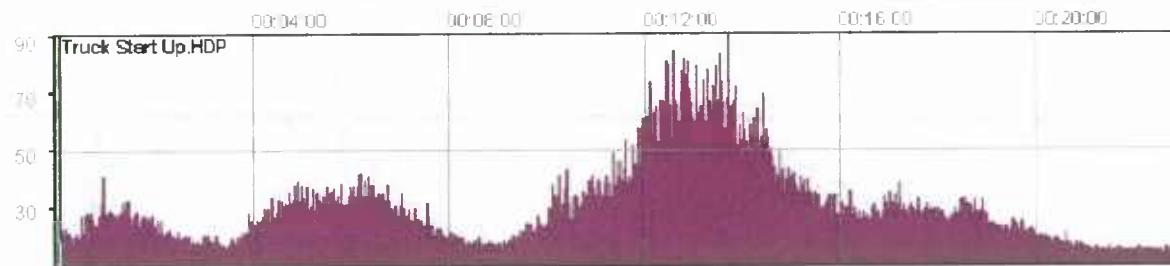


# Typical Truck Scenes

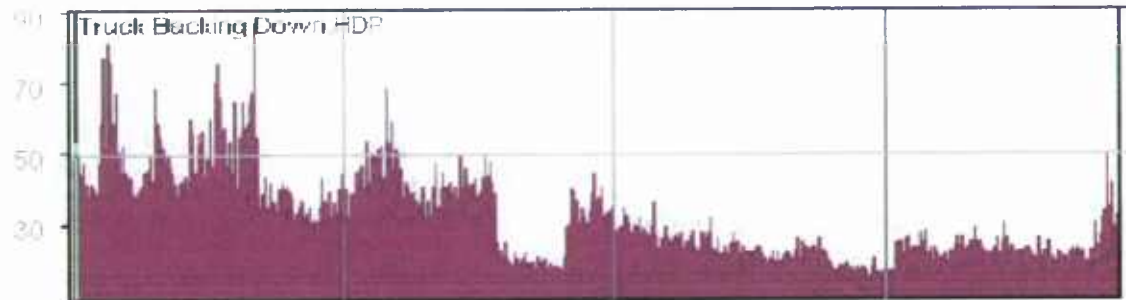


# Noise Profiles of Trucks on Shady Grove Road

Noise Profile of Truck Startup on Shady Grove Road

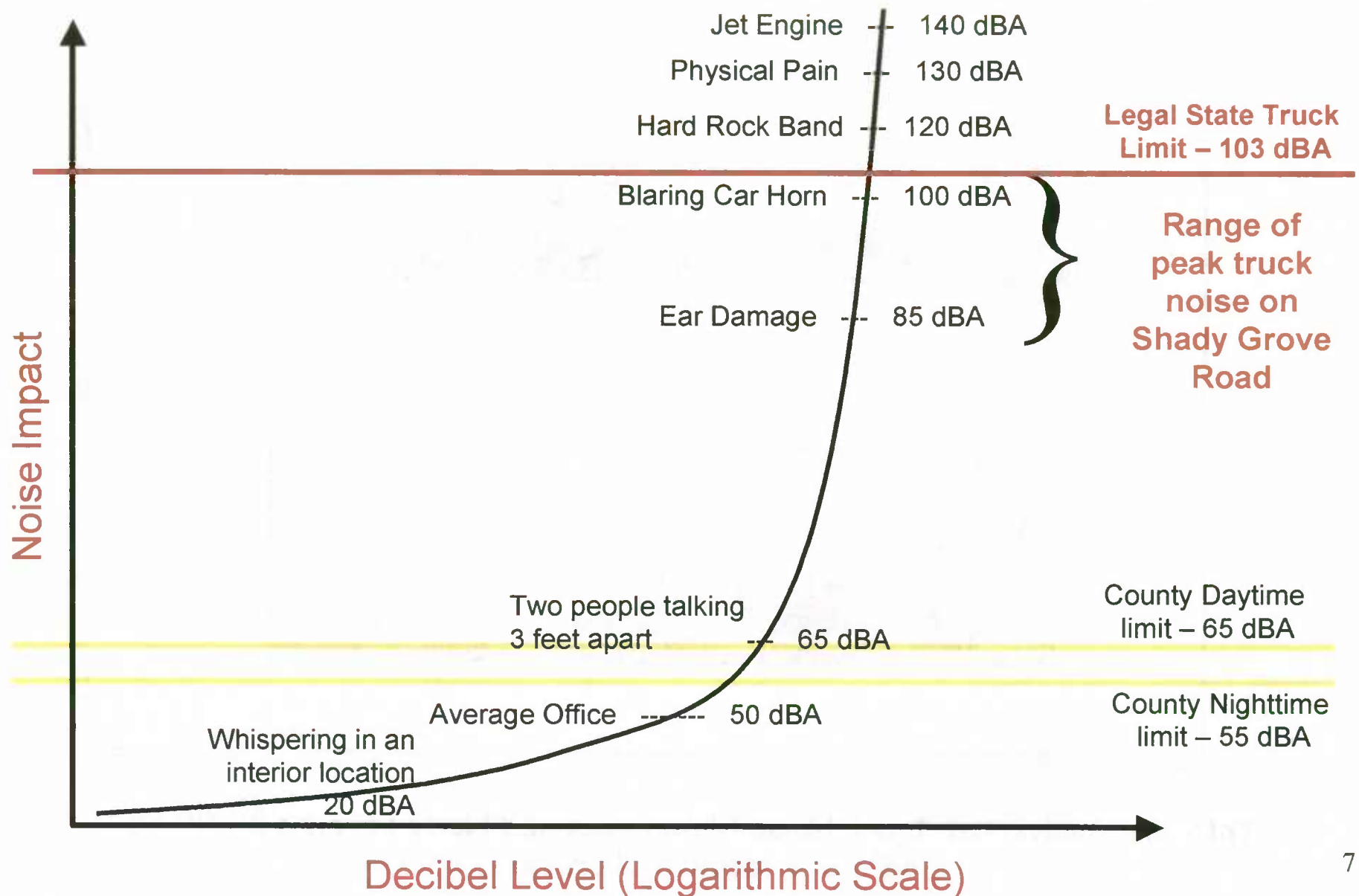


Noise Profile of Truck Wind-down on Shady Grove Road



Informal Analysis of Truck Noise Shows Received Noise Levels = 80-90 dBA at adjacent residential property lines

# Relative Impact of Noise Levels (Defined by County DEP)





## Testimony of Thomas DeGraba, MD on Noise Impacts to Health

### 5. Health Impact/ Night Trucks

- Sleep Deprivation: Increased likelihood of stimulant use (Caffeine and Nicotine)
- Hearing Loss, Ulcers, Elevated Blood Cholesterol

1) Health Impact of Nighttime Trucks: Substantial evidence exists that excessive noise and disruption of sleep/ or sleep deprivation, can have a significant negative impact on an individual's health and wellbeing. Reports from the National Institutes of Health, The National Sleep Foundation and documentation in the Montgomery County Planning Board Staff Guidelines for Noise Impact support the effects of noise and sleep deprivation on health.

- a) Auto accidents: Drowsiness and fatigue has been identified as a principle cause in at least 100,000 traffic crashes each year. In addition, about 1 million, or 1/6 of all crashes in the U.S. are believed to be attributable to lapses in driver's attention (with sleep loss significantly increasing the chances of such lapses).
- b) Sleep deprivation is reported to increase blood pressure and heart rate, resulting in increased risk of stroke and heart disease.
- c) School Performance: Lack of sleep has been associated with poor school performance, reduced short term memory, reduced learning ability, inconsistent performance and loss of some forms of behavioral control.

10

## 5. Health Impact/ Night Trucks

- **Negative Moods:** anger, depression & fear.
- **Inability to Focus: Similar Symptoms to ADHD (Response of Children)**

- a) **Negative Moods:** Lack of sleep has also been associated with decreased ability to control emotions leading to anger, depression and fear. It also impairs the ability to stay focused and problems completing tasks (resembling behaviors common in attention deficit hyperactivity disorder( ADHD)).
- b) Sleep deprivation increases the likelihood of stimulant use (including caffeine and nicotine) as well as alcohol and similar substances. (Particularly noted in adolescents)
- c) Increased noise levels are also associated with hearing loss, ulcers and other digestive disorders and elevation of blood cholesterol.

# Excerpts from Expert Testimony by Dr. Wm. Labuda

---

To the Montgomery County Planning Board  
20 July 2000

In order to understand why we cannot mitigate the truck noise, we went to a sonics expert ...

## Dr. William Labuda

- PhD, Physics, Johns Hopkins University
- 30 years experience in advanced acoustics for DOD
- Presently with Johns Hopkins University, Advanced Physics Laboratory
- Citizen representative of a Noise Study Group recently established by the County Executive

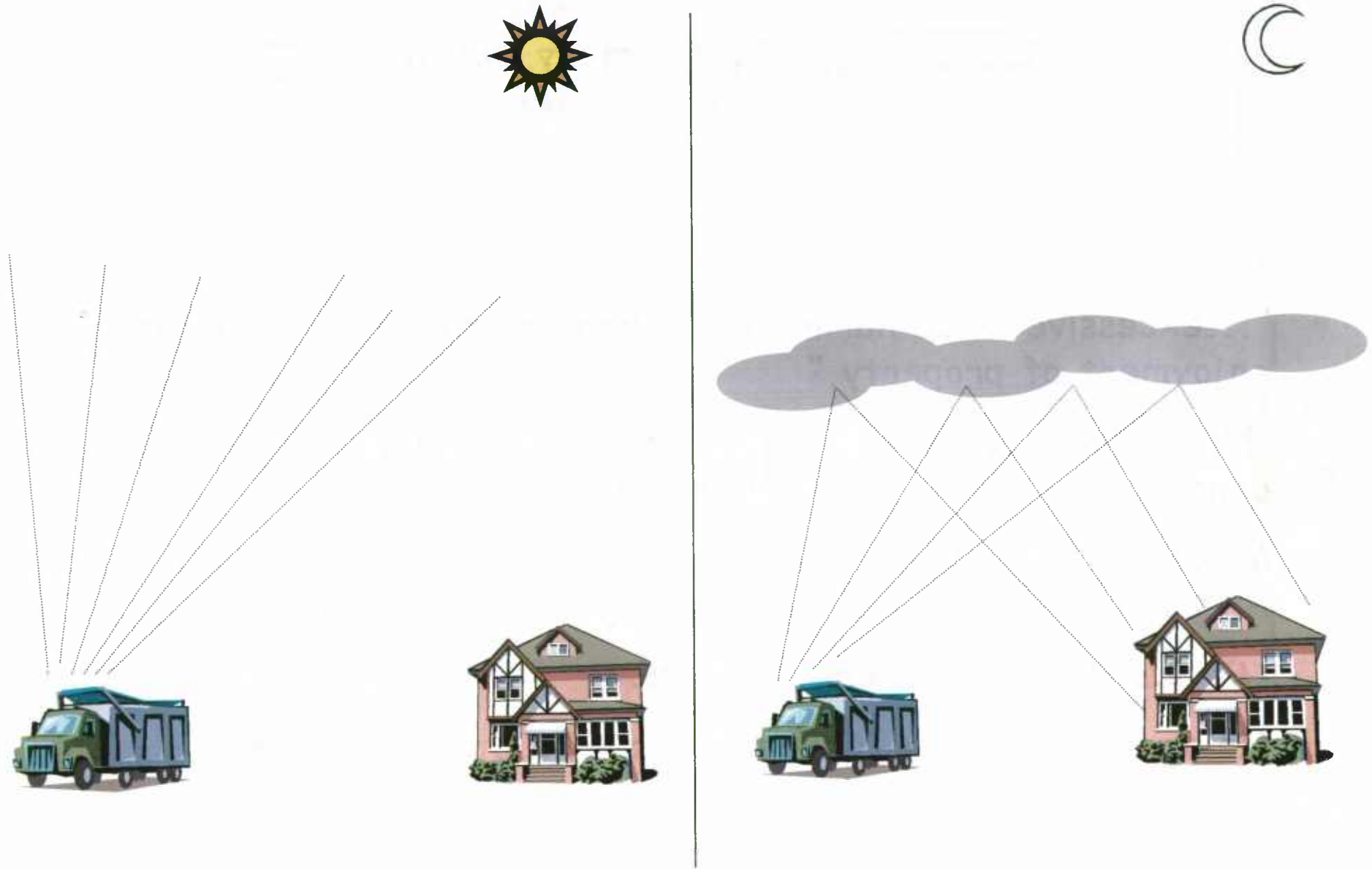


# Excerpts from Expert Testimony by Dr. Wm. Labuda

---

To the Montgomery County Planning Board  
20 July 2000

- "During the night as the earth cools through radiation, the air mass near the earth becomes cooler and a sound ducting condition is produced. Thus sound energy initially propagating upward is refracted downward toward the ground".
- This means that:
  1. *"Noise from distant sources will propagate further with greater intensity than during daytime hours, and*
  2. *... the noise will be more intrusive for a longer period of time".*
  3. *"Noise energy will be received through side walls, facing walls and for a longer period of time".*
- "Consider the noise from a truck passing by having a level of 103 dBA as measured 3 feet from its exhaust stack".
  1. *To achieve acceptable levels of noise mitigation for sleeping a nearby residence ... "would require a solid concrete wall one-foot in thickness".*
  2. *Alternatively, the dwelling would have to be sited over a mile away from the noise source!*



The Worst of All Possible Outcomes: Nighttime Noise is Not Only Destructive of Sleep and Health, But Travels Further and Penetrates Deeper Than Daytime Noise



Montgomery County Department of Environmental  
Protection

## Montgomery County Noise Ordinance

Bill No. 16-96

Concerning: Noise Control - Revision

- "...excessive noise harms public health and welfare and impairs enjoyment of property."
- "Noise disturbance means any noise that is unpleasant, annoying, offensive, loud or obnoxious."
- Maximum Allowable Noise Levels (dBA) for Receiving Noise Areas:

	<u>daytime</u>	<u>nighttime</u>
<i>Residential noise area</i>	<i>65 dBA</i>	<i>55 dBA</i>
- Montgomery County "Quiet Hours": 9:00pm to 7:00am

By amending Montgomery County Code Chapter 31B

The County Council for Montgomery County, Maryland, approves the following  
Act:

Section 1. Chapter 31B is amended as follows:

### 31B-1. Declaration of policy

(a) The County Council finds that excessive noise harms public health and welfare and impairs enjoyment of property. The intent of this Chapter is to control noise sources to



# Universal Standards for Noise Health and Safety

	World Health Organization	U.S. Environmental Protection Agency	Montgomery County DEP
Hearing Impairment Begins	> 70 dBA	> 70 dBA	> 70 dBA
Sleep Disturbance Damages Health	> 45 dBA interior	> 45 dBA interior	> 30-42 dBA
Maximum Allowable Noise - Daytime	55 dBA		65 dBA
Maximum Allowable Noise- Nighttime	45 dBA		55 dBA

Every health agency in the world recognizes that noise levels of the sort being imposed on the Shady Grove Road neighborhoods are damaging to human health and welfare!

# Excerpts from Expert Testimony by Dr. Harvey Vanveldhuizen

## On Environmental Accountability of Industrial Operations

In response to the position that quarry industries are not accountable for environmental impact outside of their boundaries, we went to an environmental expert.

### Dr. Harvey Vanveldhuizen

- PhD, University of California, Ecology
- 20 years in environmental impact assessment: mining, oil and gas, hydropower and aquatic ecology
- Has prepared more than 50 domestic Environmental Impact Assessments; a dozen international assessments
- Lead Environmental Scientist, World Bank Group

# Excerpts from Expert Testimony by Dr. Harvey Vanveldhuizen

To the State/County Meeting on Nighttime Quarry Operations  
11 October 2000

- "Considerable case law, both at the federal level and in many state jurisdictions, has clearly established a principle that environmental impact assessment must take into consideration not only the impacts of "on-site" activities, but all directly connected actions without which the "on-site" activity could not function. Thus, it is widely recognized practice in the United States that directly connected "activities," such as pipelines, transmission lines, port facilities, roads, and other support infrastructure, that must be constructed to support a project, or upon which a project directly depends, are subject to environmental impact assessment and review as parts of the whole."

COMAR Regulations on Environmental Impact: "Subsection 102 of Title 3 states that the people have a right to an environment free from any noise that jeopardizes health, property, or degrades the quality of their lives. Subsection 105 notes that local jurisdictions may have more stringent rules, but not less. Subsection 401 clearly requires the state to consider the effects of noise on sleep, psychological distress, property values, and unreasonable interference with the enjoyment of life and property. Subsections 502 and 503 demand the State agencies to comply with federal, State, and interstate requirements if the unit engages in *any activity that results in the emission of noise.*"

- "The vast majority of truck traffic on Shady Grove Road Extension is an integral part of mining and asphalt operations from inside the Rockville quarry property. **Shady Grove Road Extension is a support road for the quarry enterprises.**"
- "The source of noise that we suffer from in this neighborhood is not just any and all vehicle traffic - it is a specific type of traffic directly and inextricably linked to a nearby county-permitted industrial activity. As such, the County has an obligation to regulate that noise source, irrespective of the particular type of source, as a directly connected action to an industrial activity over which the County has regulatory authority.



## State of Maryland Position on Noise Pollution

---

**Annotated Code, Title 3-102:** "The General Assembly finds that the people of this State have a right to an environment that is free from any noise that may jeopardize their health, general welfare or property; or degrades the quality of their lives"; and "That it is essential to have coordination and Statewide leadership of the noise control activities of the many State agencies and county and local governments."

**Annotated Code, Title 3-401:** The State Department of Environment shall:

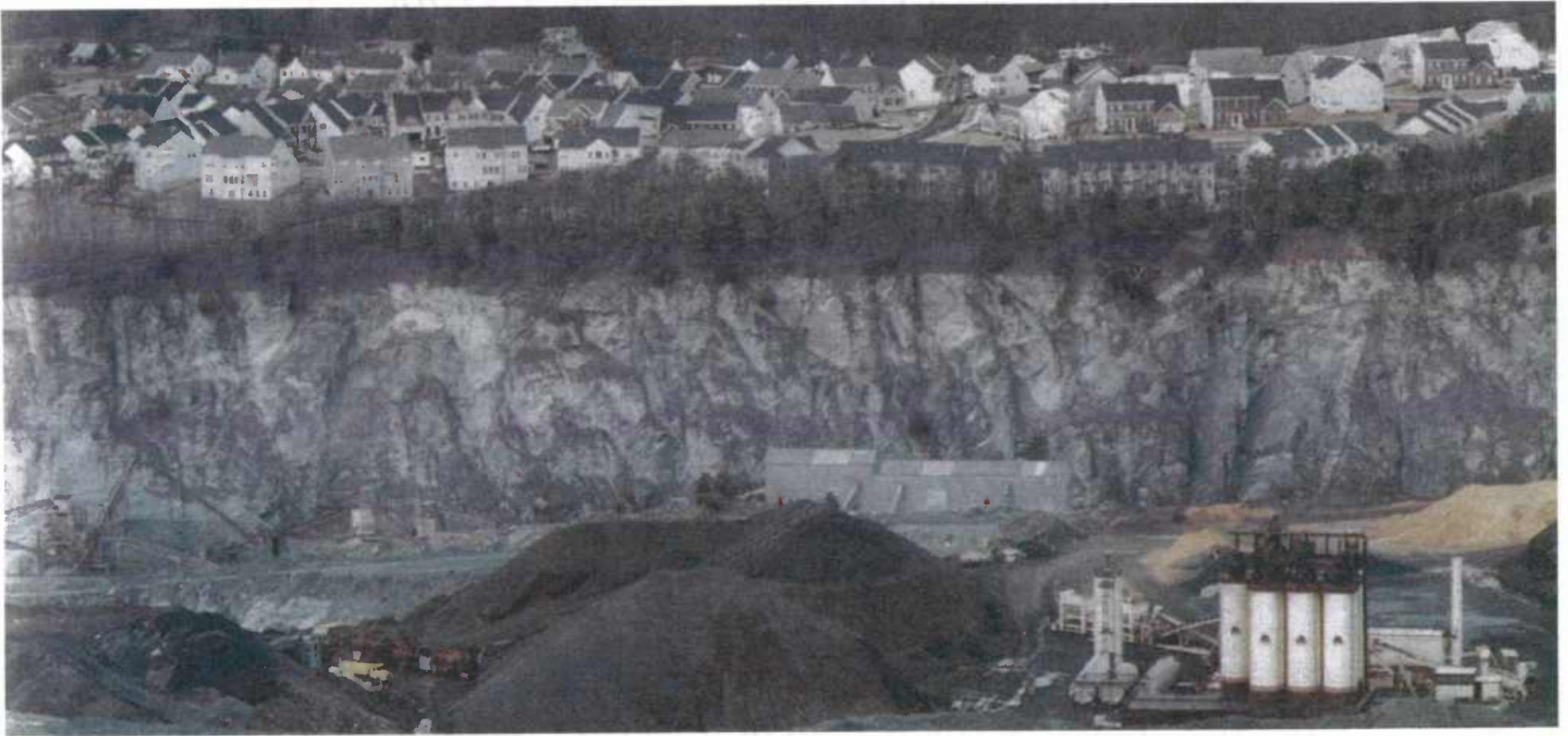
"...adopt environmental noise standards, sound level limits, and noise control rules and regulations as necessary to protect the public health, the general welfare and property."

"... consider scientific information, including temporary or permanent hearing loss; interference with sleep, speech communication, work or other human activities; adverse psychological responses; psychological distress; unreasonable interference with with the enjoyment of life or property."

**Annotated Code, Title 3-403:** "The Department shall enforce the sound level limits and noise control rules and regulation adopted under this Title."

There has been a Department-wide failure to properly interpret and enforce the intent of the State Legislature on environmental noise pollution. This Department has adopted the strategy of "compartmentalization" in order to to avoid the need for action.

## A "Creeping Nuisance": The Rockville Quarry and Its Neighbors



## Available Protections

---

- ✗ *Montgomery County Noise Ordinance*
- ✗ *MD State Truck Noise Ordinance*
- ✗ *State Permit on Quarry Hours of Operation*
- ✗ *County Quarry Ordinance on Hours of Operation*
- ✗ *State Environmental Impact Laws*

To date, none of these available protections have been enforced to protect the residents of our community



## Environmental Impact Accountability of Industrial Operations

### By Dr. Harvey Van Veldhuizen

My name is Harvey Van Veldhuizen. I am a professional Environmental Scientist with a Ph.D. from the University of California in ecology. I have spent over 20 years in environmental impact assessment, specializing in mining, oil and gas, hydropower, and aquatic ecology. In the course of my career I have prepared more than 50 Environmental Impact Statements (EISs) and Environmental Assessments (EAs) under Federal NEPA legislation, and more than a dozen environmental impact assessments prepared for projects in developing countries under local regulations and/or the US Foreign Assistance Act. I am currently the Lead Environmental Scientist with World Bank Group, working since 1993 with private sector investors in developing countries. I feel that I have a credible background in regulation and environmental impact assessment of large industrial enterprises, and I submit this study to clarify the responsibilities of such enterprises to the environment around them.

Maryland State Laws and Regulations and Montgomery County Ordinances place a high premium on protecting residents from harmful noise. Allow me to note just a few examples from Maryland State Laws and Regulations, first from the Annotated Code of Maryland Article on Environment, Title 3, which addresses Noise. Subsection 102 of Title 3 states that the people have a right to an environment free from any noise that jeopardizes health, property, or degrades the quality of their lives. Subsection 105 notes that local jurisdictions may have more stringent rules, but not less. Subsection 401 clearly requires the state to consider the effects of noise on sleep, psychological distress, property values, and unreasonable interference with the enjoyment of life and property. Subsection 401 also demands consideration of zoning and the degree of noise reduction that may be attained and maintained using best available technology. Subsections 502 and 503 demand the State agencies to comply with **federal, State, and interstate** requirements if the unit engages in *any activity that results in the emission of noise*. As you are well aware, the State regulates quarry activities.

The Maryland Department of Environment is charged with Title 26, Subtitle 21, in regulating mining. Subsection 26.21.01.04 notes in *several* places that the Department must consider potential impacts on the environment and public safety, land use, and proximity to dwellings, when considering applications for permits, *including modifications* and renewals, for mining operations. Subsection 26.21.01.03.D.(3) specifies that the State must carefully consider adjacent properties that will be affected, **and** the location of access, haul, and **support roads**. It cannot be denied that virtually all the nighttime truck traffic and the vast majority of daytime truck traffic on Shady Grove Road Extension is due to the Rockville quarry or to F.O. Day asphalt operations located therein. The quarry and F.O. Day asphalt plant could not operate without this truck traffic, and the truck traffic would disappear to almost nothing if the quarry were not operating. **Therefore, the vast majority of truck traffic on Shady Grove Road Extension is an integral part of mining and asphalt operations from inside the Rockville quarry property.** Shady Grove Road Extension is a support road for the quarry enterprises.

22

Montgomery County Ordinances, especially Chapters 31B (Noise) and 38 (Quarries), also are very clear in their concerns about noise and the need for noise to be closely controlled in residential neighborhoods. Also Subsection 38.17(e) of Chapter 38 clearly extends in full the provisions of Chapters 31B and 38 to the F.O. Day asphalt plant inside the Rockville Quarry. Chapter 31B is very strong and clear in the intent to protect property owners from adverse effects of noise. It states very clearly that the Chapter **must be liberally** construed [31B-1(a)] and the County **must** establish procedures to identify and reduce noise sources when issuing permits, variances, exemptions, or approvals [31B-1(b)(4)]. Subsection 31B-2 is full of definitions which may be construed to include any noise source including truck traffic that is directly attributable to the quarry and asphalt plant operations [ ref. 31B-2 subsections (a), (g)(1), (j), (k), (l), (m), (o), (r), and (t)]. Subsection 31B-5 addresses noise disturbance [(b)] from (among other examples) "...handling...building materials" [(c)(4)]. Section 31B-6 applies as well since it addresses as part of construction "...**delivering** materials or equipment, or loading or unloading during nighttime hours in a residential noise area" [(c)(1)].

County officials have claimed that the county is prevented from regulating noise from motor vehicles on **county** roads. Even if one were to accept the notion that the County cannot regulate noise from vehicle traffic on a **county** road, the source of noise that we suffer from in this neighborhood is not just any and all vehicle traffic – *it is a specific type of traffic directly and inextricably linked to a nearby county-permitted industrial activity*. As such, the County has an obligation to regulate that noise source, irrespective of the particular type of source, as a directly connected action to an industrial activity over which the County has regulatory authority. On this point, the conclusions of a recent letter from M-NCPPC to Mr. Duncan converge with ours. Our area is zoned residential, and traffic-generated noise from a nearby industrial operation that passes through the core of such a residential area is subject to County noise-control regulation. To quote M-NCPPC, "...if night time noise cannot be brought to a level compatible with the surrounding residential community, all night time use of Shady Grove Road south of route 28 should be eliminated."

Considerable case law, both at the federal level and in many state jurisdictions, has clearly established a principle that environmental impact assessment must take into consideration not only the impacts of "on-site" activities, but all directly connected actions without which the "on-site" activity could not function. Thus, it is widely recognized practice in the United States that directly connected "activities," such as pipelines, transmission lines, port facilities, **roads**, and other support infrastructure, that must be constructed to support a project, or upon which a project directly depends, are subject to environmental impact assessment and review as parts of the whole. Indeed, such approach is being encouraged in developing countries by the World Bank as internationally recognized best practice – does Montgomery County wish to be seen as doing much less than what developing countries are being encouraged to do?

If Montgomery County wishes to follow national practice, as well as internationally recognized best practice, in the matter of managing the environmental impacts of quarry operations, then it has sufficient regulatory authority in Chapters 31B and 38 to regulate

truck traffic activity on Shady Grove Extension that is directly produced by the nearby quarry and asphalt plant operations. Even the M-NCPPC letter to Mr. Duncan points out that the quarry ordinance "may" be a useful tool in addressing the problem. How much more so when linked to Chapter 31B, which is to be "liberally construed" to carry out [its] intent? The truck traffic on Shady Grove Road Extension between Piney Meetinghouse Road and Darnestown Road clearly qualifies in this category, especially at night. To put it another way, the County, because of a permitting decision, has clearly produced a certain type of **industrial vehicle** noise in a residential area from a certain type of **industrial vehicle** traffic as a result of a clearly identifiable, permitted, nearby **industrial** activity which produces this traffic. If the County had not permitted this **industrial** activity (at night), the specific nuisance nighttime noise from **industrial** vehicle activity would not have occurred. The County is obliged [Ordinance 31B-1(b)(4)] by its own Ordinance [Subsection 31B-2(o)] to find the most effective noise-suppression methods appropriate and reasonably available.

The County has argued that it is within its rights to waive the noise ordinance because of offsetting public benefit. However, 31B-12(a) says the Department must enforce this Chapter, and it must be liberally construed [31B-1(a)]. The County therefore must demonstrate that there are no other options than to allow this particular quarry and asphalt plant to operate on a 24/6 schedule (i.e., there is no other source of rock or asphalt in the area that could be economically competitive **and** operate at night in a manner that would avoid significant nuisance noise production in a residential neighborhood [31B-1(b)(4)]). Has the County so demonstrated that there are no other options? If the answer is that there are no other options, then the area along Shady Grove Road Extension should **never** have been zoned for residential use, and the residents may need to seek legal relief for the County taking of property values.

County officials have tried to dismiss resident complaints by stating that the F.O. Day Company has assured them that their trucks and their contractors are either unable or forbidden to use engine brakes at night. We have noted in the newspaper that the County oddly is proposing to permit nighttime quarry operations contingent upon the prohibition of the use of engine brakes. Painful experience shows that the notion that this will be effective in addressing the noise issue is preposterous. Even in a recent letter to a local resident, the responsible County official has scoffed at the efficacy of posting signs to prevent illegal actions. Law enforcement is also sadly ineffective -- truckers have 2-way radios, as everyone knows, and often radar detectors. The moment a police cruiser is spotted on Shady Grove Road Extension, all truck traffic instantly knows and quickly slows down to speed limit, and quiets down. The moment the police cruiser leaves, the speed and noise resume. The County is clearly unable, or unwilling, to effectively enforce noise restrictions from truck traffic on Shady Grove Road Extension, especially at night.

In conclusion, going back to both State Regulations [Annotated Code, Title 3, Subsection 401] and County Ordinances [Chapter 31B-2(o)], there is therefore only one reasonable and effective solution to this problem --- eliminate all nighttime operations within the Rockville Quarry, including the operation of the asphalt plant and delivery of any and all materials outside the gates. We urge the State and County to deny requested permit

24

waivers to allow the quarry to operate at night, and urge the County to revoke waivers to allow industrial operations within the quarry to haul materials out the gate at night.

Harvey Van Velhuizen, PhD  
10303 Procera Dr.  
Rockville, MD 20850-5476  
240-453-9863





4/2/01 24

-2-

Nancy Banner (Adv. Council member) Rosedale

Video (window rattles)

hoit recyl. plant

low-freq. rumble (like det. jet engine)

Public info

- Cecil Co. Dragway (estab. for youth racing (get off streets. etc.))

\* increase in operations (duration & days)

- "grandfathering" issue

- 600 feet distance (sample) <sup>1/2</sup> mile

- June 4<sup>th</sup> - ('83-'88, '93 - residents)

- muffling systems (not required)

- jet cars

- time ~~rest~~ of operation expanded

- @ mid 70's it closest (clear audible -)

\* (- page 42/43 exemptions (sanctioned auto racing facil.) hours - 7 AM - 12 M. (noon))

- 74 residents (increase in operations over time)

- smoke / pollution

~~Quarry~~

- Quarry - Mont. Co / Shady Grove

"Creeping Nuisance"

- existing laws -> (hand-out)

- Citation -> power / enforcement

next mtg - May 7<sup>th</sup>

- Pre-date -
- Type II. -

Continuous noise: Videos

European Background  
ambient standards?

\* LON → make goals of 55  
the noise standard?

\* Look @ CNEEL.

& check w/  
MTA

\* Vibration issue  
(16/32/64 Hz.) ⇒

\* Lit. search

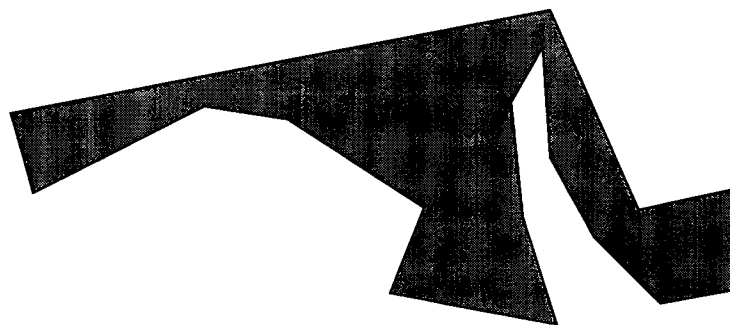
\* Tom O'Leary -  
marib. Co.  
next mtg

First Mon. Apr.  
4/2/01  
next  
mtg.

Steve Federline  
(MN-CRRC)

# Maryland State Highway Administration

## Sound Barrier Policy



Presentation 3/5/01  
to Interagency  
Noise Control  
Committee.



State Highway Administration  
Sound Barrier Policy  
May 11, 1998

# POLICY HISTORY

Decisions have been made under three policy periods (pre 1987, 1987- 1998 , and the current 1998 policy).

- Pre 1987 : No written Policy.
- 1987-1998 : First written Policy, little detail (2 pages)
  - 1992/93 : Beginnings of studies for Policy revisions.
  - 1995: Major Policy guidance by FHWA.
- The May 1998 Sound Barrier Policy currently in force (12 pages long).

# REGULATORY BASIS

- 23 Code of Fed.Regs. (CFR) Part 7.7.2
  - NEPA -1969
  - Fed-Aid Highway Act - 1970
- PPM 90-2 - 1972
- FHPM 7-7-3 - May, 1976
- Other guiding documents
  - EPA “Levels document - March, 1974

# POLICY IS A STEP PROCESS

- DATE
- NOISE LEVEL
- FEASIBILITY
- REASONABLENESS
  - COST
  - \$50,000 or less per benefited residence.



# Basic Tenets of the Policy

- Noise impact in the outdoor living space - SHA will *CONSIDER* noise abatement.
  - Through no fault of their own
  - Construction of home either before a highway is approved for initial construction or widening.
  - Persons are not disqualified if they buy a pre-dating home after the highway is built or widened.

# Basic Tenets of the Policy

- Builder/buyer - beware
  - persons who build a home near an existing highway should expect traffic growth and an accompanying increase in noise levels.

# NOISE LEVEL CRITERIA















- Approach or exceed
  - $L_{eq}(h)$  - 67 decibels(dBA) or
  - $L_{10}(h)$  - 70 dBA
- SHA CRITERIA -  $L_{eq}(h)$  - 66 dBA
- Factors upon which level is based:
  - Speech interference (typical conversation @ 3 feet, 60-65 dBA)
  - Activity interference (phone, TV, etc.)
  - Sleep disturbance

# HIGHWAY NOISE STUDIES

- MEASUREMENTS - EXISTING LEVELS
  - 24 - HOUR
  - SHORT-TERM
- PREDICTION - FUTURE LEVELS
  - FHWA approved computer models



# Typical Noises In Our Environment

- 130 dBA Near Threshold of Pain 
- 120 dBA Near a Jet Aircraft Take-Off 
- 110 dBA Noise Level in Audience at Rock Concert 
- 100 dBA Gas Lawn Mower at 3 Feet 
- 90 dBA On Sidewalk Near Heavy Truck 
- 80 dBA Shouting at 3 Feet 
- 70 dBA Vacuum Cleaner at 10 Feet 
- **66 dBA SHA Impact Threshold** 
- 60 dBA Normal Speech at 3 Feet 
- 50 dBA Business Office 
- 40 dBA Typical Noise Level for Suburban Nighttime 
- 30 dBA Library 
- 20 dBA Quiet Countryside 
- 10 dBA Hearing Testing Booth 
- 0 dBA Threshold of Hearing

# SHA Highway Noise Abatement Programs

Type I

Type II

TYPE I: when new highway construction takes place or an existing highway is expanded

## TYPE I projects include:

- Reconstruction and/or widening including lane additions of one mile or more
- Highway on new location
- Realignment of existing highway
- Interchange reconstruction/reconfiguration

TYPE II: when sound barriers are proposed for an existing highway, where no other highway improvements are being planned



## TYPE II Projects

- For homes which pre-date the construction of the original highway.
- Through no fault of their own are impacted by highway noise.
- Owner could not have envisioned the degree or extent of the highway noise that would be generated.

# CAVEAT

- Date of eligibility based on housing “build” date
- Does not consider occupancy date

# Policy Terminology:

- Feasibility
- Reasonableness

# Feasibility

- Engineering and acoustical ability of barrier to provide effective noise reduction (7-10 decibels)
  - SHA's Goal - 10 dBA reduction at the noisiest locations.
- No major impacts to the environment or utilities
- Any Right-of-Way must be donated by home owners

# Reasonableness

- Is it reasonable to build a barrier?
- Noise levels and impact determination
- Cost
- “Benefited” residences

• 75% Approval required.



# *Perception of Change in Intensity Levels*

Change in Level (dBA)	Human Perception
-1	Imperceptible
-3	Just Perceptible
-5	Clearly Noticeable
-10	1/2 as Loud (SHA Design Goal)
-20	1/4 as Loud

# LOCAL REQUIREMENTS

- Page 8 of Policy
- Type I - Share results of studies
- Type II - Requires local jurisdiction to implement ordinances or requirements on developers

# LIMITED SHA ROLE

- Technical assistance
  - Review developer noise studies and site development plans
  - Guidance in developing local noise control ordinances or programs
- Information resource
  - Present / Future noise levels for highway

THANK YOU

?????????????? 'S

9:30 Review Agenda

9:35 Announce public input process  
(five minutes for any public observer - starting at 11:30 AM)

9:40 Review of the minutes from Feb. 5<sup>th</sup> meeting

9:45 Brief announcements or comments by any members

9:50 Presentation by MDOT..... Ken Polcak

10:15 Legislative Update

10:20 Issue Number 1 --- Continuous Noise - Applicability of Table 1 ..... George Harman

10:45 Break

10:55 Discussion of Issue 1

11:20 Issue 2 - Vibrations (introduction if time allows) ..... George Harman

11:30 Discussion of Issue 2 or Public input (if speakers are present)

12:00 Adjourn

Legislative Update:

SB 376	Senator Norman Stone	3 inspectors at MDE vs. 1
	MDE takes no position	
	Provides letter advising that outreach to local governments and Council will clarify situations that have caused workload	
SB 868	Senator Jimeno	gun club exemptions
869	MDE still reviewing the bill	
	Prevents 15 counties from regulating gun club noise	
	Prevents the State from regulating in 14 counties	

Process

Discuss all issues then seek consensus and recommendations  
Recommendations will then be formally presented to the Council  
Council will then have 60 days to advise the Secretary

Rationale: Some issues are overlapping and we would prefer to have any changes reviewed in context with the entire package.

Issues to be addressed (sequence to be determined by Council)

- 1 - continuous noises (March meeting)
- 2 - vibration
  - ground vs. air (low frequency sound as a source)
- 3 - agricultural equipment
- 4 - gun clubs
  - sporting events
- 5 - application of regulations by complaint or by zoning classification
- 6 - impulse definition - easy
- 7 - household tools
  - include leaf blowers
- 8 - household pets
- 9 - air conditioners
- 10 - rock concerts - onsite noise regulation ME or DHVH
- 11 - drag racing/NASCAR
- 12 - variance - expenses by applicant
- 13 - other topics as presented



## CONTINUOUS NOISE

### Background:

We currently enforce maximum noise levels.

Generally: 65 dBA day and 55 dBA night

In urban and suburban areas – daytime background is often up to 55 dBA.

Thus, the background levels mask perception of continuous noises in this range.

Nighttime background levels are usually much lower (e.g. 30–40 dBA in suburban situations).

Thus, 55 dBA can be annoying at night in these locations.

A secondary goal was established 25 years ago – Table I in the regulations = 55 dBA

$L_{dn}$ .

We have had many complaints and issues concerning continuous noises:

Walter Reed

T. Rowe Price

Wilkins-Rogers

TPS Technologies

Power Plants

Typical quote: "Sounds like a freight train coming, but it never arrives".

### REFRESHER DEFINITIONS

dB = decibel

dB in linear measurement = not A-weighted, absolute values

dBA = decibels, A-weighted, to mimic human perception

$L_d$  = average for daytime hours

$L_n$  = average for nighttime hours

$L_{eq}(24)$  = 24-hour average, dBA  $L_{eq}(24)$  = 24-hour average A-weighted noise level

$L_{dn}$  = calculated (see attached example) 24-hour day/night average with a 10 dBA penalty for nighttime hours

Our question for consideration – Should the goals stated in 02.B (specifically the Table I values), be established as a standard?

It could be argued that we already have the standard, but a close reading of the language in the regulations, shows that the text links the words standards and goals in a manner that is ambiguous.

- (1) The standards are goals for the attainment of an adequate environment. The standards set out in Regulation .03 are intended to achieve these goals.
- (2) The following sound levels represent the standards for the State by general zoning district:

Table 1

Environmental Noise Standards

Industrial	70 dBA	$L_{eq}(24)$
Commercial	64 dBA	$L_{dn}$
Residential	55 dBA	$L_{dn}$

Some might say that the ambiguity could allow for the State to implement the goal as a standard. However, there is a legal precedent that states that if a regulation is not implemented, and remains on the books as an unimplemented standard, the State must present the regulation for public and review and comment before it begins implementing it.

Therefore, if the Council finds that Table I levels should be firmly established as standards, we propose the package found in Tab 1 of the loose leaf binder. In addition to the change in the text, we would also move the Table from 02 to 03.

**Implications:**

This could apply to a large number of facilities.

This could affect HVAC units, such as at Walter Reed Hospital.

This could affect HVA units in strip shopping centers that back up to residential properties.

This would affect power companies that are planning rural power plants (ODEC in Cecil, Kelson Ridge in Charles, eastern shore chicken waste processing plants, and other commercial facilities such as TPS Technologies in Rosedale).

On the surface, a 55 dBA  $L_{dn}$  doesn't seem different than the application of the Table II maximum levels.

However, in the definitions for  $L_{dn}$ , 10 dBA is added to nighttime levels in the calculation. Thus, nighttime levels of 55 are converted to 65 for purposes of calculating a  $L_{dn}$ . Thus, a continuous 55 dBA source will exceed a 55  $L_{dn}$  if the facility operates 24 hours per day.

A 24-hour operation would, therefore, need to operate a 48.6 dBA to achieve a 55 dBA  $L_{dn}$ .

Or, the facility would need to cease operations for a portion or all of the nighttime hours.

### Example for calculating a $L_{dn}$

$L_d$  = average dBA level for the hours between 7 AM and 10 PM (15 hours)

$L_n$  = average dBA level for the hours between 10 PM and 7 AM (9 hours)

$L_n + 10$  = dBA level for the hours between 10 PM to 7 AM with 10 dBA added in consideration of the relative effects of nighttime noise

For a facility operating continuously at 55 dBA for 24-hours per day:

Formula:

$$10 \log_{10} \left[ \frac{15(10)^{(L_d/10)} + 9(10)^{(L_n+10/10)}}{24} \right]$$

$$10 \log_{10} \left[ \frac{15(10)^{(55/10)} + 9(10)^{(55+10)/10}}{24} \right]$$

$$10 \log_{10} \left[ \frac{15(10)^{5.5} + 9(10)^{6.5}}{24} \right]$$

$$10 \log_{10} \left[ \frac{15(316,228) + 9(3,162,278)}{24} \right]$$

$$10 \log_{10} \left[ \frac{4,743,420 + 28,460,499}{24} \right]$$

$$10 \log_{10} (1,383,497)$$

$$10(6.14)$$

$$61.4 \text{ dBA } L_{dn}$$

Example calculations for a continuous noise operating at 48.6 dBA:

Formula:

$$10 \log_{10} \frac{[15(10)^{(L_d/10)} + 9(10)^{(L_n+10/10)}]}{24}$$

$$10 \log_{10} \frac{[15(10)^{(48.6/10)} + 9(10)^{(48.6+10/10)}]}{24}$$

$$10 \log_{10} \frac{[15(10)^{4.86} + 9(10)^{5.86}]}{24}$$

$$10 \log_{10} \frac{[15(72.443) + 9(724.436)]}{24}$$

$$10 \log_{10} \frac{[1,086,645 + 6,519,924]}{24}$$

$$10 \log_{10} (316,940)$$

$$10(5.5)$$

$$55.0 \text{ dBA } L_{dn}$$

	Maximum	Idn
Current	55	61.4
	53	59.4
	52	58.4
	50	56.4
Goal	48.6	55.0



# Interagency Noise Control Committee

2/5/01 59

w/ Noise Advisory Council

- Public input period  
at end of each mtg.

- Someone in place @ mtg (no vote, must be actual member)

1. 4. Epstein - Med. Aspects

3<sup>rd</sup> most common ailment - hearing loss (noise pollution exposure)

500 - 2500 Hz (4000)

10 m w/ hearing loss

Ed. History EPA - Ken Felt

Presentation points

- Focus  
levels  
annoyance  
communication  
levels.

\* Copy of Policy  
Typical levels

Wgt. Davis - DNR Noise  
Auth. - 8-725-4

90 dBA. → permitted levels \* (dist ?) ✓  
~~Exceptions~~ (within vessel.)

24 hr. test  
example

\* Wildlife - provisions

MOSH -

~~Non~~ Non-employment exposure  
not corrected

2/5/01. W

DHMH

- no program  
- shift to MDE - early/mid 80's

- Outdoor music fests.  
COMAR - 10-16-05 (Business Regs)

## Process

potential changes to Law/regs

□ Continuous noise

### Complaint history

- cannons @ Constellation 1 day on weekends
- fire sirens
- rock concerts
- drag strips / race car
- church bells
- leaf blowers
- portable power tools
- vibrations (complicated issues)

HVAC units

mechanical equipment

\* issue: differential over background (L90)

Shopping centers

Power plants

next mtg. Mar 5<sup>th</sup> - First Mon. @ ch. month

-3-

2/5/01 bel

\* Review changes → next mtg (Mar. 5<sup>th</sup>)

□ Pres. 56A view.

62

**MARYLAND OCCUPATIONAL  
SAFETY AND HEALTH  
(MOSH)**

Bill Grabau, CIH  
(410) 767-2209  
william.grabau@osha.gov

---

---

---

---

---

---

---

**Occupational Noise Exposure  
(29 CFR 1910.95)**

- Adopted by MOSH in 1973
- Sections (c) - (p) and Appendices A-I adopted by MOSH in 1983
  - OSHA's Hearing Conservation Amendment
- Applies where there are employer/employee relationships
- Does not apply to volunteers or the general public

---

---

---

---

---

---

---

**Permissible Exposure Level**

- 90 dBA
  - 8-hour Time Weighted Average (TWA)
- Required to be reduced through the use of:
  - engineering controls
  - administrative controls
  - personal protective equipment (PPE)
- PPE provided at no cost

---

---

---

---

---

---

---

**Action Level**

- 85 dBA
  - 8-hour TWA
- Required to implement a Hearing Conservation Program
  - monitoring
  - audiometric testing
  - employee training

5 dBA exchange rate

~~90 @ 8 hrs~~

85 @ 8 hrs

90 @ 4 hrs

95 @ 2 hrs

100 @ 1 hr.

etc.

20HA- 500, 1K, 2K, 3K, 4K, 6K

**Employee Exposure Monitoring**

- Must be reflective of employee noise exposure
  - integrate levels between 80 and 130 dB
- Repeat when changes in processes, equipment or controls increase exposure
- Employees notified of results if > 85dBA
- Employee reps permitted to observe monitoring

**Audiometric Testing**

- Required for employee noise exposure > 85 dBA (8-hour TWA)
- No cost to employee
- Performed by qualified individual
- Must be performed within 6 months of first exposure > 85 dBA (8-hr TWA)
  - Van exception
- Test at 500, 1000, 2000, 3000, 4000 and 6000 Hz
- Conducted annually

64

### Audiogram Evaluation

- Compare baseline with most recent test
  - calculate Standard Threshold Shifts (STS)
    - >10 dB change, relative to baseline, at 2000, 3000 or 4000 Hz (either ear)
- Follow-up procedures if an STS occurs
  - Require hearing protection
  - Additional training
  - Medical review
- Revise baseline audiogram

---

---

---

---

---

---

---

---

### Hearing Protection

- No cost to the employee
- Made available where 8-hour TWA > 85dBA, but < 90 dBA
- Required to be worn when:
  - 8-hour TWA > 90 dBA
  - STS is detected
  - 8-hour TWA exceeds 85 dBA and no baseline audiogram given in first 6 months

---

---

---

---

---

---

---

---

### Hearing Protection (cont'd)

- Employees permitted to choose from a selection of devices
- Employer must assure proper fitting and attenuation
  - TWA - (NRR - 7) OSHA method
  - TWA - (NRR - 7) Real world
- Must attenuate to an 8-hour TWA of 90 dBA, or 85 dBA where there is an STS

2

---

---

---

---

---

---

---

---

65

### Access to Information

- Employer must make standard available
  - Provide copies upon request of employees or designated reps
- Employer must post copy of standard in the workplace

---

---

---

---

---

---

---

### Training

- Required where 8-hour TWA > 85 dBA
- Repeated annually
- Must include:
  - effects of noise on hearing
  - purpose, attenuation, advantages and disadvantages of types of hearing protectors
  - selection, fitting, use and care of hearing protectors
  - purpose of audiometric testing and explanation of test procedures

---

---

---

---

---

---

---

### Recordkeeping

- Keep copies of exposure monitoring and audiograms
- Retention schedule
  - exposure monitoring - 2 years
  - audiograms - duration of employee's employment
- Access to records
  - 29 CFR 1910.1020

---

---

---

---

---

---

---



66

### **Appendices**

- **Appendices A - E are mandatory**
  - A - Noise Exposure Computation
  - B - Estimating Protection Attenuation
  - C - Audiometric Measuring Instruments
  - D - Audiometric Test Rooms
  - E - Calibration of Audiometers
- **Appendices F and G are non-mandatory**

---

---

---

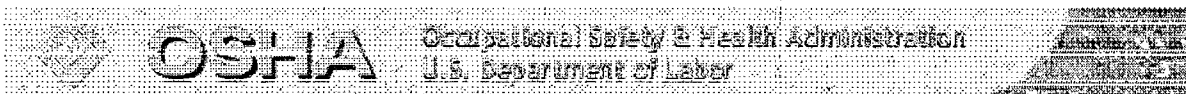
---

---

---

---

67

**OSHA Regulations (Standards - 29 CFR)****Occupational noise exposure. - 1910.95**

---

**OSHA Regulations (Standards - 29 CFR) - Table of Contents**

---

- **Standard Number:** 1910.95
- **Standard Title:** Occupational noise exposure.
- **SubPart Number:** G
- **SubPart Title:** Occupational Health and Environmental Control

**Interpretation(s)****(a)**

Protection against the effects of noise exposure shall be provided when the sound levels exceed those shown in Table G-16 when measured on the A scale of a standard sound level meter at slow response. When noise levels are determined by octave band analysis, the equivalent A-weighted sound level may be determined as follows:

FIGURE G-9 - Equivalent A-Weighted Sound Level  
(For Figure G-9, [Click Here](#))

Equivalent sound level contours. Octave band sound pressure levels may be converted to the equivalent A-weighted sound level by plotting them on this graph and noting the A-weighted sound level corresponding to the point of highest penetration into the sound level contours. This equivalent A-weighted sound level, which may differ from the actual A-weighted sound level of the noise, is used to determine exposure limits from Table 1.G-16.

**(b)****(b)(1)**

When employees are subjected to sound exceeding those listed in Table G-16, feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels within the levels of Table G-16, personal protective equipment shall be provided and used to reduce sound levels within the levels of the table.

**(b)(2)**

If the variations in noise level involve maxima at intervals of 1 second or less, it is to be considered continuous.

---

TABLE G-16 - PERMISSIBLE NOISE EXPOSURES (1)

---

68

Duration per day, hours	Sound level dBA slow response
8.....	90
6.....	92
4.....	95
3.....	97
2.....	100
1 1/2 .....	102
1.....	105
1/2 .....	110
1/4 or less.....	115

Footnote(1) When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions:  $C(1)/T(1) + C(2)/T(2) + C(n)/T(n)$  exceeds unity, then, the mixed exposure should be considered to exceed the limit value.  $C_n$  indicates the total time of exposure at a specified noise level, and  $T_n$  indicates the total time of exposure permitted at that level. Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

#### ..1910.95(c)

(c)

"Hearing conservation program."

(c)(1)

The employer shall administer a continuing, effective hearing conservation program, as described in paragraphs (c) through (o) of this section, whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level (TWA) of 85 decibels measured on the A scale (slow response) or, equivalently, a dose of fifty percent. For purposes of the hearing conservation program, employee noise exposures shall be computed in accordance with appendix A and Table G-16a, and without regard to any attenuation provided by the use of personal protective equipment.

(c)(2)

For purposes of paragraphs (c) through (n) of this section, an 8-hour time-weighted average of 85 decibels or a dose of fifty percent shall also be referred to as the action level.

(d)

"Monitoring."

(d)(1)

When information indicates that any employee's exposure may equal or exceed an 8-hour time-weighted average of 85 decibels, the employer shall develop and implement a monitoring program.

(d)(1)(i)

The sampling strategy shall be designed to identify employees for inclusion in the hearing conservation program and to enable the proper selection of hearing protectors.

(d)(1)(ii)

Where circumstances such as high worker mobility, significant variations in sound level, or a significant component of impulse noise make area monitoring generally inappropriate, the employer shall use representative personal sampling to comply with the monitoring requirements of this paragraph unless the employer can show that area sampling produces equivalent results.

..1910.95(d)(2)

(d)(2)

(d)(2)(i)

All continuous, intermittent and impulsive sound levels from 80 decibels to 130 decibels shall be integrated into the noise measurements.

(d)(2)(ii)

Instruments used to measure employee noise exposure shall be calibrated to ensure measurement accuracy.

(d)(3)

Monitoring shall be repeated whenever a change in production, process, equipment or controls increases noise exposures to the extent that:

(d)(3)(i)

Additional employees may be exposed at or above the action level; or

(d)(3)(ii)

The attenuation provided by hearing protectors being used by employees may be rendered inadequate to meet the requirements of paragraph (j) of this section.

(e)

"Employee notification." The employer shall notify each employee exposed at or above an 8-hour time-weighted average of 85 decibels of the results of the monitoring.

(f)

"Observation of monitoring." The employer shall provide affected employees or their representatives with an opportunity to observe any noise measurements conducted pursuant to this section.

..1910.95(g)

(g)

"Audiometric testing program."

(g)(1)

The employer shall establish and maintain an audiometric testing program as provided in this paragraph by making audiometric testing available to all employees whose exposures equal or exceed

an 8-hour time-weighted average of 85 decibels.

(g)(2)

The program shall be provided at no cost to employees.

(g)(3)

Audiometric tests shall be performed by a licensed or certified audiologist, otolaryngologist, or other physician, or by a technician who is certified by the Council of Accreditation in Occupational Hearing Conservation, or who has satisfactorily demonstrated competence in administering audiometric examinations, obtaining valid audiograms, and properly using, maintaining and checking calibration and proper functioning of the audiometers being used. A technician who operates microprocessor audiometers does not need to be certified. A technician who performs audiometric tests must be responsible to an audiologist, otolaryngologist or physician.

(g)(4)

All audiograms obtained pursuant to this section shall meet the requirements of Appendix C: "Audiometric Measuring Instruments."

(g)(5)

"Baseline audiogram."

(g)(5)(i)

Within 6 months of an employee's first exposure at or above the action level, the employer shall establish a valid baseline audiogram against which subsequent audiograms can be compared.

..1910.95(g)(5)(ii)

(g)(5)(ii)

"Mobile test van exception." Where mobile test vans are used to meet the audiometric testing obligation, the employer shall obtain a valid baseline audiogram within 1 year of an employee's first exposure at or above the action level. Where baseline audiograms are obtained more than 6 months after the employee's first exposure at or above the action level, employees shall wearing hearing protectors for any period exceeding six months after first exposure until the baseline audiogram is obtained.

(g)(5)(iii)

Testing to establish a baseline audiogram shall be preceded by at least 14 hours without exposure to workplace noise. Hearing protectors may be used as a substitute for the requirement that baseline audiograms be preceded by 14 hours without exposure to workplace noise.

(g)(5)(iv)

The employer shall notify employees of the need to avoid high levels of non-occupational noise exposure during the 14-hour period immediately preceding the audiometric examination.

(g)(6)

"Annual audiogram." At least annually after obtaining the baseline audiogram, the employer shall obtain a new audiogram for each employee exposed at or above an 8-hour time-weighted average of

85 decibels.

71

(g)(7)

"Evaluation of audiogram."

(g)(7)(i)

Each employee's annual audiogram shall be compared to that employee's baseline audiogram to determine if the audiogram is valid and if a standard threshold shift as defined in paragraph (g)(10) of this section has occurred. This comparison may be done by a technician.

..1910.95(g)(7)(ii)

(g)(7)(ii)

If the annual audiogram shows that an employee has suffered a standard threshold shift, the employer may obtain a retest within 30 days and consider the results of the retest as the annual audiogram.

(g)(7)(iii)

The audiologist, otolaryngologist, or physician shall review problem audiograms and shall determine whether there is a need for further evaluation. The employer shall provide to the person performing this evaluation the following information:

(g)(7)(iii)(A)

A copy of the requirements for hearing conservation as set forth in paragraphs (c) through (n) of this section;

(g)(7)(iii)(B)

The baseline audiogram and most recent audiogram of the employee to be evaluated;

(g)(7)(iii)(C)

Measurements of background sound pressure levels in the audiometric test room as required in Appendix D: Audiometric Test Rooms.

(g)(7)(iii)(D)

Records of audiometer calibrations required by paragraph (h)(5) of this section.

..1910.95(g)(8)

(g)(8)

"Follow-up procedures."

(g)(8)(i)

If a comparison of the annual audiogram to the baseline audiogram indicates a standard threshold shift as defined in paragraph (g)(10) of this section has occurred, the employee shall be informed of this fact in writing, within 21 days of the determination.

72

**(g)(8)(ii)**

Unless a physician determines that the standard threshold shift is not work related or aggravated by occupational noise exposure, the employer shall ensure that the following steps are taken when a standard threshold shift occurs:

**(g)(8)(ii)(A)**

Employees not using hearing protectors shall be fitted with hearing protectors, trained in their use and care, and required to use them.

**(g)(8)(ii)(B)**

Employees already using hearing protectors shall be refitted and retrained in the use of hearing protectors and provided with hearing protectors offering greater attenuation if necessary.

**(g)(8)(ii)(C)**

The employee shall be referred for a clinical audiological evaluation or an otological examination, as appropriate, if additional testing is necessary or if the employer suspects that a medical pathology of the ear is caused or aggravated by the wearing of hearing protectors.

**(g)(8)(ii)(D)**

The employee is informed of the need for an otological examination if a medical pathology of the ear that is unrelated to the use of hearing protectors is suspected.

**..1910.95(g)(8)(iii)****(g)(8)(iii)**

If subsequent audiometric testing of an employee whose exposure to noise is less than an 8-hour TWA of 90 decibels indicates that a standard threshold shift is not persistent, the employer:

**(g)(8)(iii)(A)**

Shall inform the employee of the new audiometric interpretation; and

**(g)(8)(iii)(B)**

May discontinue the required use of hearing protectors for that employee.

**(g)(9)**

"Revised baseline." An annual audiogram may be substituted for the baseline audiogram when, in the judgment of the audiologist, otolaryngologist or physician who is evaluating the audiogram:

**(g)(9)(i)**

The standard threshold shift revealed by the audiogram is persistent; or

**(g)(9)(ii)**

The hearing threshold shown in the annual audiogram indicates significant improvement over the baseline audiogram.



(g)(10)

"Standard threshold shift."

(g)(10)(i)

As used in this section, a standard threshold shift is a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear.

..1910.95(g)(10)(ii)

(g)(10)(ii)

In determining whether a standard threshold shift has occurred, allowance may be made for the contribution of aging (presbycusis) to the change in hearing level by correcting the annual audiogram according to the procedure described in Appendix F: "Calculation and Application of Age Correction to Audiograms."

(h)

"Audiometric test requirements."

(h)(1)

Audiometric tests shall be pure tone, air conduction, hearing threshold examinations, with test frequencies including as a minimum 500, 1000, 2000, 3000, 4000, and 6000 Hz. Tests at each frequency shall be taken separately for each ear.

(h)(2)

Audiometric tests shall be conducted with audiometers (including microprocessor audiometers) that meet the specifications of, and are maintained and used in accordance with, American National Standard Specification for Audiometers, S3.6-1969, which is incorporated by reference as specified in Sec. 1910.6.

(h)(3)

Pulsed-tone and self-recording audiometers, if used, shall meet the requirements specified in Appendix C: "Audiometric Measuring Instruments."

(h)(4)

Audiometric examinations shall be administered in a room meeting the requirements listed in Appendix D: "Audiometric Test Rooms."

..1910.95(h)(5)

(h)(5)

"Audiometer calibration."

(h)(5)(i)

The functional operation of the audiometer shall be checked before each day's use by testing a person with known, stable hearing thresholds, and by listening to the audiometer's output to make sure that the output is free from distorted or unwanted sounds. Deviations of 10 decibels or greater require an acoustic calibration.

74  
(h)(5)(ii)

Audiometer calibration shall be checked acoustically at least annually in accordance with Appendix E: "Acoustic Calibration of Audiometers." Test frequencies below 500 Hz and above 6000 Hz may be omitted from this check. Deviations of 15 decibels or greater require an exhaustive calibration.

(h)(5)(iii)

An exhaustive calibration shall be performed at least every two years in accordance with sections 4.1.2; 4.1.3.; 4.1.4.3; 4.2; 4.4.1; 4.4.2; 4.4.3; and 4.5 of the American National Standard Specification for Audiometers, S3.6-1969. Test frequencies below 500 Hz and above 6000 Hz may be omitted from this calibration.

(i)

"Hearing protectors."

(i)(1)

Employers shall make hearing protectors available to all employees exposed to an 8-hour time-weighted average of 85 decibels or greater at no cost to the employees. Hearing protectors shall be replaced as necessary.

(i)(2)

Employers shall ensure that hearing protectors are worn:

(i)(2)(i)

By an employee who is required by paragraph (b)(1) of this section to wear personal protective equipment; and

..1910.95(i)(2)(ii)

(i)(2)(ii)

By any employee who is exposed to an 8-hour time-weighted average of 85 decibels or greater, and who:

(i)(2)(ii)(A)

Has not yet had a baseline audiogram established pursuant to paragraph (g)(5)(ii); or

(i)(2)(ii)(B)

Has experienced a standard threshold shift.

(i)(3)

Employees shall be given the opportunity to select their hearing protectors from a variety of suitable hearing protectors provided by the employer.

(i)(4)

The employer shall provide training in the use and care of all hearing protectors provided to

75

employees.

(i)(5)

The employer shall ensure proper initial fitting and supervise the correct use of all hearing protectors.

(j)

"Hearing protector attenuation."

(j)(1)

The employer shall evaluate hearing protector attenuation for the specific noise environments in which the protector will be used. The employer shall use one of the evaluation methods described in Appendix B: "Methods for Estimating the Adequacy of Hearing Protection Attenuation."

..1910.95(j)(2)

(j)(2)

Hearing protectors must attenuate employee exposure at least to an 8-hour time-weighted average of 90 decibels as required by paragraph (b) of this section.

(j)(3)

For employees who have experienced a standard threshold shift, hearing protectors must attenuate employee exposure to an 8-hour time-weighted average of 85 decibels or below.

(j)(4)

The adequacy of hearing protector attenuation shall be re-evaluated whenever employee noise exposures increase to the extent that the hearing protectors provided may no longer provide adequate attenuation. The employer shall provide more effective hearing protectors where necessary.

(k)

"Training program."

(k)(1)

The employer shall institute a training program for all employees who are exposed to noise at or above an 8-hour time-weighted average of 85 decibels, and shall ensure employee participation in such program.

(k)(2)

The training program shall be repeated annually for each employee included in the hearing conservation program. Information provided in the training program shall be updated to be consistent with changes in protective equipment and work processes.

(k)(3)

The employer shall ensure that each employee is informed of the following:

..1910.95(k)(3)(i)

(k)(3)(i)

The effects of noise on hearing;

(k)(3)(ii)

The purpose of hearing protectors, the advantages, disadvantages, and attenuation of various types, and instructions on selection, fitting, use, and care; and

(k)(3)(iii)

The purpose of audiometric testing, and an explanation of the test procedures.

(i)

"Access to information and training materials."

(l)(1)

The employer shall make available to affected employees or their representatives copies of this standard and shall also post a copy in the workplace.

(l)(2)

The employer shall provide to affected employees any informational materials pertaining to the standard that are supplied to the employer by the Assistant Secretary.

(l)(3)

The employer shall provide, upon request, all materials related to the employer's training and education program pertaining to this standard to the Assistant Secretary and the Director.

..1910.95(m)

(m)

"Recordkeeping" -

(m)(1)

"Exposure measurements." The employer shall maintain an accurate record of all employee exposure measurements required by paragraph (d) of this section.

(m)(2)

"Audiometric tests."

(m)(2)(i)

The employer shall retain all employee audiometric test records obtained pursuant to paragraph (g) of this section:

(m)(2)(ii)

This record shall include:

(m)(2)(ii)(A)

Name and job classification of the employee;

(m)(2)(ii)(B)

Date of the audiogram;

(m)(2)(ii)(C)

The examiner's name;

(m)(2)(ii)(D)

Date of the last acoustic or exhaustive calibration of the audiometer; and

(m)(2)(ii)(E)

Employee's most recent noise exposure assessment.

(m)(2)(ii)(F)

The employer shall maintain accurate records of the measurements of the background sound pressure levels in audiometric test rooms.

(m)(3)

"Record retention." The employer shall retain records required in this paragraph (m) for at least the following periods.

..1910.95(m)(3)(i)

(m)(3)(i)

Noise exposure measurement records shall be retained for two years.

(m)(3)(ii)

Audiometric test records shall be retained for the duration of the affected employee's employment.

(m)(4)

"Access to records." All records required by this section shall be provided upon request to employees, former employees, representatives designated by the individual employee, and the Assistant Secretary. The provisions of 29 CFR 1910.20 (a)-(e) and (g)-

(m)(4)(i)

apply to access to records under this section.

(m)(5)

"Transfer of records." If the employer ceases to do business, the employer shall transfer to the successor employer all records required to be maintained by this section, and the successor employer shall retain them for the remainder of the period prescribed in paragraph (m)(3) of this section.

7A

(n)

"Appendices."

(n)(1)

Appendices A, B, C, D, and E to this section are incorporated as part of this section and the contents of these appendices are mandatory.

..1910.95(n)(2)

(n)(2)

Appendices F and G to this section are informational and are not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

(o)

"Exemptions." Paragraphs (c) through (n) of this section shall not apply to employers engaged in oil and gas well drilling and servicing operations.

(p)

"Startup date." Baseline audiograms required by paragraph (g) of this section shall be completed by March 1, 1984.

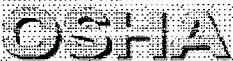
[39 FR 23502, June 27, 1974, as amended at 46 FR 4161, Jan. 16, 1981; 46 FR 62845, Dec. 29, 1981; 48 FR 9776, Mar. 8, 1983; 48 FR 29687, June 28, 1983; 54 FR 24333, June 7, 1989; 61 FR 5507, Feb. 13, 1996; 61 FR 9227, March 7, 1996]

---

OSHA Regulations (Standards - 29 CFR) - Table of Contents

---

79



Occupational Safety & Health Administration  
U.S. Department of Labor

## OSHA Regulations (Standards - 29 CFR)

### Noise exposure computation - 1910.95 App A

#### OSHA Regulations (Standards - 29 CFR) - Table of Contents

- Standard Number: 1910.95 App A
- Standard Title: Noise exposure computation
- SubPart Number: G
- SubPart Title: Occupational Health and Environmental Control

This Appendix is Mandatory

#### I. Computation of Employee Noise Exposure

(1) Noise dose is computed using Table G-16a as follows:

(i) When the sound level, L, is constant over the entire work shift, the noise dose, D, in percent, is given by:  $D=100 C/T$  where C is the total length of the work day, in hours, and T is the reference duration corresponding to the measured sound level, L, as given in Table G-16a or by the formula shown as a footnote to that table.

(ii) When the workshift noise exposure is composed of two or more periods of noise at different levels, the total noise dose over the work day is given by:

$$D = 100 (C(1)/T(1) + C(2)/T(2) + \dots + C(n)/T(n)),$$

where C(n) indicates the total time of exposure at a specific noise level, and T(n) indicates the reference duration for that level as given by Table G-16a.

(2) The eight-hour time-weighted average sound level (TWA), in decibels, may be computed from the dose, in percent, by means of the formula:  $TWA = 16.61 \log(10) (D/100) + 90$ . For an eight-hour workshift with the noise level constant over the entire shift, the TWA is equal to the measured sound level.

(3) A table relating dose and TWA is given in Section II.

TABLE G-16A

A-weighted sound level, L (decibel)	Reference duration, T (hour)
80.....	32
81.....	27.9
82.....	24.3
83.....	21.1
84.....	18.4
85.....	16

86.....	13.9
87.....	12.1
88.....	10.6
89.....	9.2
90.....	8
91.....	7.0
92.....	6.1
93.....	5.3
94.....	4.6
95.....	4
96.....	3.5
97.....	3.0
98.....	2.6
99.....	2.3
100.....	2
101.....	1.7
102.....	1.5
103.....	1.3
104.....	1.1
105.....	1
106.....	0.87
107.....	0.76
108.....	0.66
109.....	0.57
110.....	0.5
111.....	0.44
112.....	0.38
113.....	0.33
114.....	0.29
115.....	0.25
116.....	0.22
117.....	0.19
118.....	0.16
119.....	0.14
120.....	0.125
121.....	0.11
122.....	0.095
123.....	0.082
124.....	0.072
125.....	0.063
126.....	0.054
127.....	0.047
128.....	0.041
129.....	0.036
130.....	0.031

40

In the above table the reference duration, T, is computed by

$$T = \frac{8}{2^{(L-90)/5}}$$

where L is the measured A-weighted sound level.

## II. Conversion Between "Dose" and "8-Hour Time-Weighted Average"

### Sound Level

Compliance with paragraphs (c)-(r) of this regulation is determined by the amount of exposure to noise in the workplace. The amount of such exposure is usually measured with an audiodosimeter which gives a readout in terms of "dose." In order to better understand the



requirements of the amendment, dosimeter readings can be converted to an "8-hour time-weighted average sound level." (TWA).

In order to convert the reading of a dosimeter into TWA, see Table A-1, below. This table applies to dosimeters that are set by the manufacturer to calculate dose or percent exposure according to the relationships in Table G-16a. So, for example, a dose of 91 percent over an eight hour day results in a TWA of 89.3 dB, and, a dose of 50 percent corresponds to a TWA of 85 dB.

If the dose as read on the dosimeter is less than or greater than the values found in Table A-1, the TWA may be calculated by using the formula:  $TWA = 16.61 \log(10) (D/100) + 90$  where TWA=8-hour time-weighted average sound level and D = accumulated dose in percent exposure.

41

TABLE A-1 - CONVERSION FROM "PERCENT NOISE EXPOSURE"  
OR "DOSE" TO "8-HOUR TIME-WEIGHTED  
AVERAGE SOUND LEVEL" (TWA)

Dose or percent noise exposure	TWA
10 .....	73.4
15 .....	76.3
20 .....	78.4
25 .....	80.0
30 .....	81.3
35 .....	82.4
40 .....	83.4
45 .....	84.2
50 .....	85.0
55 .....	85.7
60 .....	86.3
65 .....	86.9
70 .....	87.4
75 .....	87.9
80 .....	88.4
81 .....	88.5
82 .....	88.6
83 .....	88.7
84 .....	88.7
85 .....	88.8
86 .....	88.9
87 .....	89.0
88 .....	89.1
89 .....	89.2
90 .....	89.2
91 .....	89.3
92 .....	89.4
93 .....	89.5
94 .....	89.6
95 .....	89.6
96 .....	89.7
97 .....	89.8
98 .....	89.9
99 .....	89.9
100 .....	90.0
101 .....	90.1
102 .....	90.1
103 .....	90.2
104 .....	90.3
105 .....	90.4
106 .....	90.4
107 .....	90.5
108 .....	90.6

82

109	90.6
110	90.7
111	90.8
112	90.8
113	90.9
114	90.9
115	91.1
116	91.1
117	91.1
118	91.2
119	91.3
120	91.3
125	91.6
130	91.9
135	92.2
140	92.4
145	92.7
150	92.9
155	93.2
160	93.4
165	93.6
170	93.8
175	94.0
180	94.2
185	94.4
190	94.6
195	94.8
200	95.0
210	95.4
220	95.7
230	96.0
240	96.3
250	96.6
260	96.9
270	97.2
280	97.4
290	97.7
300	97.9
310	98.2
320	98.4
330	98.6
340	98.8
350	99.0
360	99.2
370	99.4
380	99.6
390	99.8
400	100.0
410	100.2
420	100.4
430	100.5
440	100.7
450	100.8
460	101.0
470	101.2
480	101.3
490	101.5
500	101.6
510	101.8
520	101.9
530	102.0
540	102.2
550	102.3

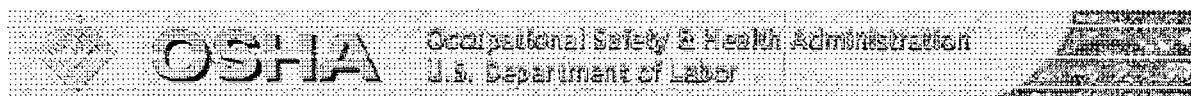
83

560	102.4
570	102.6
580	102.7
590	102.8
600	102.9
610	103.0
620	103.2
630	103.3
640	103.4
650	103.5
660	103.6
670	103.7
680	103.8
690	103.9
700	104.0
710	104.1
720	104.2
730	104.3
740	104.4
750	104.5
760	104.6
770	104.7
780	104.8
790	104.9
800	105.0
810	105.1
820	105.2
830	105.3
840	105.4
850	105.4
860	105.5
870	105.6
880	105.7
890	105.8
900	105.8
910	105.9
920	106.0
930	106.1
940	106.2
950	106.2
960	106.3
970	106.4
980	106.5
990	106.5
999	106.6

---

#### OSHA Regulations (Standards - 29 CFR) - Table of Contents

---



## OSHA Regulations (Standards - 29 CFR)

### Methods for estimating the adequacy of hearing protector attenuation - 1910.95 App B

#### OSHA Regulations (Standards - 29 CFR) - Table of Contents

- **Standard Number:** 1910.95 App B
- **Standard Title:** Methods for estimating the adequacy of hearing protector attenuation
- **SubPart Number:** G
- **SubPart Title:** Occupational Health and Environmental Control

This Appendix is Mandatory

For employees who have experienced a significant threshold shift, hearing protector attenuation must be sufficient to reduce employee exposure to a TWVA of 85 dB. Employers must select one of the following methods by which to estimate the adequacy of hearing protector attenuation.

The most convenient method is the Noise Reduction Rating (NRR) developed by the Environmental Protection Agency (EPA). According to EPA regulation, the NRR must be shown on the hearing protector package. The NRR is then related to an individual worker's noise environment in order to assess the adequacy of the attenuation of a given hearing protector. This appendix describes four methods of using the NRR to determine whether a particular hearing protector provides adequate protection within a given exposure environment. Selection among the four procedures is dependent upon the employer's noise measuring instruments.

Instead of using the NRR, employers may evaluate the adequacy of hearing protector attenuation by using one of the three methods developed by the National Institute for Occupational Safety and Health (NIOSH), which are described in the "List of Personal Hearing Protectors and Attenuation Data," HEW Publication No. 76-120, 1975, pages 21-37. These methods are known as NIOSH methods No. 1, No. 2 and No. 3. The NRR described below is a simplification of NIOSH method No. 2. The most complex method is NIOSH method No. 1, which is probably the most accurate method since it uses the largest amount of spectral information from the individual employee's noise environment. As in the case of the NRR method described below, if one of the NIOSH methods is used, the selected method must be applied to an individual's noise environment to assess the adequacy of the attenuation. Employers should be careful to take a sufficient number of measurements in order to achieve a representative sample for each time segment.

**NOTE:** The employer must remember that calculated attenuation values reflect realistic values only to the extent that the protectors are properly fitted and worn.

When using the NRR to assess hearing protector adequacy, one of the following methods must be

45

used:

(i) When using a dosimeter that is capable of C-weighted measurements:

(A) Obtain the employee's C-weighted dose for the entire workshift, and convert to TWA (see appendix A, II).

(B) Subtract the NRR from the C-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(ii) When using a dosimeter that is not capable of C-weighted measurements, the following method may be used:

(A) Convert the A-weighted dose to TWA (see appendix A).

(B) Subtract 7 dB from the NRR.

(C) Subtract the remainder from the A-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(iii) When using a sound level meter set to the A-weighting network:

(A) Obtain the employee's A-weighted TWA.

(B) Subtract 7 dB from the NRR, and subtract the remainder from the A-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(iv) When using a sound level meter set on the C-weighting network:

(A) Obtain a representative sample of the C-weighted sound levels in the employee's environment.

(B) Subtract the NRR from the C-weighted average sound level to obtain the estimated A-weighted TWA under the ear protector.

(v) When using area monitoring procedures and a sound level meter set to the A-weighting network:

(A) Obtain a representative sound level for the area in question.

40

(B) Subtract 7 dB from the NRR and subtract the remainder from the A-weighted sound level for that area.

(vi) When using area monitoring procedures and a sound level meter set to the C-weighting network:

(A) Obtain a representative sound level for the area in question.

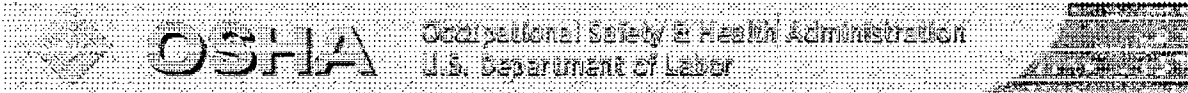
(B) Subtract the NRR from the C-weighted sound level for that area.

---

OSHA Regulations (Standards - 29 CFR) - Table of Contents

---

49

**OSHA Regulations (Standards - 29 CFR)****Audiometric measuring instruments - 1910.95 App C****OSHA Regulations (Standards - 29 CFR) - Table of Contents**

- **Standard Number:** 1910.95 App C
- **Standard Title:** Audiometric measuring instruments
- **SubPart Number:** G
- **SubPart Title:** Occupational Health and Environmental Control

**Interpretation(s)****This Appendix is Mandatory**

1. In the event that pulsed-tone audiometers are used, they shall have a tone on-time of at least 200 milliseconds.

2. Self-recording audiometers shall comply with the following requirements:

(A) The chart upon which the audiogram is traced shall have lines at positions corresponding to all multiples of 10 dB hearing level within the intensity range spanned by the audiometer. The lines shall be equally spaced and shall be separated by at least 1/4 inch. Additional increments are optional. The audiogram pen tracings shall not exceed 2 dB in width.

(B) It shall be possible to set the stylus manually at the 10-dB increment lines for calibration purposes.

(C) The slewing rate for the audiometer attenuator shall not be more than 6 dB/sec except that an initial slewing rate greater than 6 dB/sec is permitted at the beginning of each new test frequency, but only until the second subject response.

(D) The audiometer shall remain at each required test frequency for 30 seconds (+ or - 3 seconds). The audiogram shall be clearly marked at each change of frequency and the actual frequency change of the audiometer shall not deviate from the frequency boundaries marked on the audiogram by more than + or - 3 seconds.

(E) It must be possible at each test frequency to place a horizontal line segment parallel to the time

46

axis on the audiogram, such that the audiometric tracing crosses the line segment at least six times at that test frequency. At each test frequency the threshold shall be the average of the midpoints of the tracing excursions.

---

4 OSHA Regulations (Standards - 29 CFR) - Table of Contents

---



49

**OSHA**Occupational Safety & Health Administration  
U.S. Department of Labor**OSHA Regulations (Standards - 29 CFR)****Audiometric test rooms - 1910.95 App D****OSHA Regulations (Standards - 29 CFR) - Table of Contents**

- **Standard Number:** 1910.95 App D
- **Standard Title:** Audiometric test rooms
- **SubPart Number:** G
- **SubPart Title:** Occupational Health and Environmental Control

**Interpretation(s)**

This Appendix is Mandatory

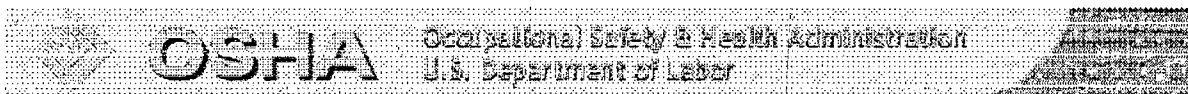
Rooms used for audiometric testing shall not have background sound pressure levels exceeding those in Table D-1 when measured by equipment conforming at least to the Type 2 requirements of American National Standard Specification for Sound Level Meters, S1.4-1971 (R1976), and to the Class II requirements of American National Standard Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets, S1.11-1971 (R1976).

TABLE D-1 - MAXIMUM ALLOWABLE OCTAVE-BAND SOUND PRESSURE LEVELS  
FOR AUDIOMETRIC TEST ROOMS

Octave-band center frequency (Hz).....	500	1000	2000	4000	8000
Sound pressure level (dB) ...	40	40	47	57	62

**OSHA Regulations (Standards - 29 CFR) - Table of Contents**

90

**OSHA Regulations (Standards - 29 CFR)****Acoustic calibration of audiometers - 1910.95 App E****OSHA Regulations (Standards - 29 CFR) - Table of Contents**

- **Standard Number:** 1910.95 App E
- **Standard Title:** Acoustic calibration of audiometers
- **SubPart Number:** G
- **SubPart Title:** Occupational Health and Environmental Control

This Appendix is Mandatory

Audiometer calibration shall be checked acoustically, at least annually, according to the procedures described in this appendix. The equipment necessary to perform these measurements is a sound level meter, octave-band filter set, and a National Bureau of Standards 9A coupler. In making these measurements, the accuracy of the calibrating equipment shall be sufficient to determine that the audiometer is within the tolerances permitted by American Standard Specification for Audiometers, S3.6-1969.

(1) "Sound Pressure Output Check"

A. Place the earphone coupler over the microphone of the sound level meter and place the earphone on the coupler.

B. Set the audiometer's hearing threshold level (HTL) dial to 70 dB.

C. Measure the sound pressure level of the tones at each test frequency from 500 Hz through 6000 Hz for each earphone.

D. At each frequency the readout on the sound level meter should correspond to the levels in Table E-1 or Table E-2, as appropriate, for the type of earphone, in the column entitled "sound level meter reading."

(2) "Linearity Check"

A. With the earphone in place, set the frequency to 1000 Hz and the HTL dial on the audiometer to 70

dB.

B. Measure the sound levels in the coupler at each 10-dB decrement from 70 dB to 10 dB, noting the sound level meter reading at each setting.

C. For each 10-dB decrement on the audiometer the sound level meter should indicate a corresponding 10 dB decrease.

D. This measurement may be made electrically with a voltmeter connected to the earphone terminals.

### (3) "Tolerances"

When any of the measured sound levels deviate from the levels in Table E-1 or Table E-2 by + or - 3 dB at any test frequency between 500 and 3000 Hz, 4 dB at 4000 Hz, or 5 dB at 6000 Hz, an exhaustive calibration is advised. An exhaustive calibration is required if the deviations are greater than 15 dB or greater at any test frequency.

TABLE E-1 - REFERENCE THRESHOLD LEVELS FOR TELEPHONICS -  
TDH-39 EARPHONES

Frequency, Hz	Reference threshold level for TDH-39 earphones, dB	Sound level meter reading, dB
500 .....	11.5	81.5
1000 .....	7	77
2000 .....	9	79
3000 .....	10	80
4000 .....	9.5	79.5
6000 .....	15.5	85.5

TABLE E-2 - REFERENCE THRESHOLD LEVELS FOR TELEPHONICS -  
TDH-49 EARPHONES

Frequency, Hz	Reference threshold level for TDH-49 earphones, dB	Sound level meter reading, dB
500 .....	13.5	83.5
1000 .....	7.5	77.5
2000 .....	11	81.0
3000 .....	9.5	79.5
4000 .....	10.5	80.5
6000 .....	13.5	83.5

q2

---

OSHA Regulations (Standards - 29 CFR) - Table of Contents

---

93

 OSHAOccupational Safety & Health Administration  
U.S. Department of Labor**OSHA Regulations (Standards - 29 CFR)****Calculations and application of age corrections to audiograms - 1910.95 App F****OSHA Regulations (Standards - 29 CFR) - Table of Contents**

- **Standard Number:** 1910.95 App F
- **Standard Title:** Calculations and application of age corrections to audiograms
- **SubPart Number:** G
- **SubPart Title:** Occupational Health and Environmental Control

**This Appendix Is Non-Mandatory**

In determining whether a standard threshold shift has occurred, allowance may be made for the contribution of aging to the change in hearing level by adjusting the most recent audiogram. If the employer chooses to adjust the audiogram, the employer shall follow the procedure described below. This procedure and the age correction tables were developed by the National Institute for Occupational Safety and Health in the criteria document entitled "Criteria for a Recommended Standard . . . Occupational Exposure to Noise," ((HSM)-11001).

For each audiometric test frequency;

(i) Determine from Tables F-1 or F-2 the age correction values for the employee by:

(A) Finding the age at which the most recent audiogram was taken and recording the corresponding values of age corrections at 1000 Hz through 6000 Hz;

(B) Finding the age at which the baseline audiogram was taken and recording the corresponding values of age corrections at 1000 Hz through 6000 Hz.

(ii) Subtract the values found in step (i)(B) from the value found in step (i)(A).

(iii) The differences calculated in step (ii) represented that portion of the change in hearing that may be due to aging.

**EXAMPLE:** Employee is a 32-year-old male. The audiometric history for his right ear is shown in decibels below.

94

Employee's age	Audiometric test frequency (Hz)				
	1000	2000	3000	4000	6000
26.....	10	5	5	10	5
*27.....	0	0	0	5	5
28.....	0	0	0	10	5
29.....	5	0	5	15	5
30.....	0	5	10	20	10
31.....	5	10	20	15	15
*32.....	5	10	10	25	20

The audiogram at age 27 is considered the baseline since it shows the best hearing threshold levels. Asterisks have been used to identify the baseline and most recent audiogram. A threshold shift of 20 dB exists at 4000 Hz between the audiograms taken at ages 27 and 32.

(The threshold shift is computed by subtracting the hearing threshold at age 27, which was 5, from the hearing threshold at age 32, which is 25). A retest audiogram has confirmed this shift. The contribution of aging to this change in hearing may be estimated in the following manner:

Go to Table F-1 and find the age correction values (in dB) for 4000 Hz at age 27 and age 32.

	Frequency (Hz)				
	1000	2000	3000	4000	6000
Age 32.....	6	5	7	10	14
Age 27.....	5	4	6	7	11
Difference	1	1	1	3	3

The difference represents the amount of hearing loss that may be attributed to aging in the time period between the baseline audiogram and the most recent audiogram. In this example, the difference at 4000 Hz is 3 dB. This value is subtracted from the hearing level at 4000 Hz, which in the most recent audiogram is 25, yielding 22 after adjustment. Then the hearing threshold in the baseline audiogram at 4000 Hz (5) is subtracted from the adjusted annual audiogram hearing threshold at 4000 Hz (22). Thus the age-corrected threshold shift would be 17 dB (as opposed to a threshold shift of 20 dB without age correction).

TABLE F-1 - AGE CORRECTION VALUES IN DECIBELS FOR MALES

Years	Audiometric Test Frequency (Hz)				
	1000	2000	3000	4000	6000
20 or younger.....	5	3	4	5	8
21 .....	5	3	4	5	8
22 .....	5	3	4	5	8

95

23 .....	5	3	4	6	9
24 .....	5	3	5	6	9
25 .....	5	3	5	7	10
26 .....	5	4	5	7	10
27 .....	5	4	6	7	11
28 .....	6	4	6	8	11
29 .....	6	4	6	8	12
30 .....	6	4	6	9	12
31 .....	6	4	7	9	13
32 .....	6	5	7	10	14
33 .....	6	5	7	10	14
34 .....	6	5	8	11	15
35 .....	7	5	8	11	15
36 .....	7	5	9	12	16
37 .....	7	6	9	12	17
38 .....	7	6	9	13	17
39 .....	7	6	10	14	18
40 .....	7	6	10	14	19
41 .....	7	6	10	14	20
42 .....	8	7	11	16	20
43 .....	8	7	12	16	21
44 .....	8	7	12	17	22
45 .....	8	7	13	18	23
46 .....	8	8	13	19	24
47 .....	8	8	14	19	24
48 .....	9	8	14	20	25
49 .....	9	9	15	21	26
50 .....	9	9	16	22	27
51 .....	9	9	16	23	28
52 .....	9	10	17	24	29
53 .....	9	10	18	25	30
54 .....	10	10	18	26	31
55 .....	10	11	19	27	32
56 .....	10	11	20	28	34
57 .....	10	11	21	29	35
58 .....	10	12	22	31	36
59 .....	11	12	22	32	37
60 or older .....	11	13	23	33	38

TABLE F-2 - AGE CORRECTION VALUES IN DECIBELS FOR FEMALES

Years	Audiometric Test Frequency (Hz)				
	1000	2000	3000	4000	6000
20 or younger.....	7	4	3	3	6
21 .....	7	4	4	3	6
22 .....	7	4	4	4	6
23 .....	7	5	4	4	7
24 .....	7	5	4	4	7
25 .....	8	5	4	4	7
26 .....	8	5	5	4	8
27 .....	8	5	5	5	8
28 .....	8	5	5	5	8
29 .....	8	5	5	5	9
30 .....	8	6	5	5	9
31 .....	8	6	6	5	9
32 .....	9	6	6	6	10
33 .....	9	6	6	6	10
34 .....	9	6	6	6	10

96

35 .....	9	6	7	7	11
36 .....	9	7	7	7	11
37 .....	9	7	7	7	12
38 .....	10	7	7	7	12
39 .....	10	7	8	8	12
40 .....	10	7	8	8	13
41 .....	10	8	8	8	13
42 .....	10	8	9	9	13
43 .....	11	8	9	9	14
44 .....	11	8	9	9	14
45 .....	11	8	10	10	15
46 .....	11	9	10	10	15
47 .....	11	9	10	11	16
48 .....	12	9	11	11	16
49 .....	12	9	11	11	16
50 .....	12	10	11	12	17
51 .....	12	10	12	12	17
52 .....	12	10	12	13	18
53 .....	13	10	13	13	18
54 .....	13	11	13	14	19
55 .....	13	11	14	14	19
56 .....	13	11	14	15	20
57 .....	13	11	15	15	20
58 .....	14	12	15	16	21
59 .....	14	12	16	16	21
60 or older .....	14	12	16	17	22

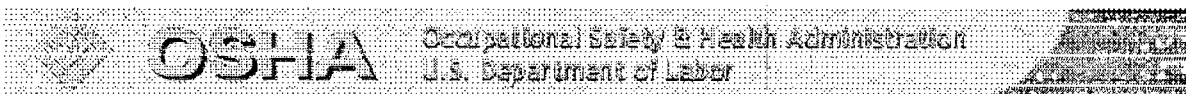
---

#### OSHA Regulations (Standards - 29 CFR) - Table of Contents

---



97



## OSHA Regulations (Standards - 29 CFR)

### Monitoring noise levels non-mandatory informational appendix - 1910.95 App G

---

#### OSHA Regulations (Standards - 29 CFR) - Table of Contents

---

- **Standard Number:** 1910.95 App G
  - **Standard Title:** Monitoring noise levels non-mandatory informational appendix
  - **SubPart Number:** G
  - **SubPart Title:** Occupational Health and Environmental Control
- 

This appendix provides information to help employers comply with the noise monitoring obligations that are part of the hearing conservation amendment.

#### WHAT IS THE PURPOSE OF NOISE MONITORING?

This revised amendment requires that employees be placed in a hearing conservation program if they are exposed to average noise levels of 85 dB or greater during an 8 hour workday. In order to determine if exposures are at or above this level, it may be necessary to measure or monitor the actual noise levels in the workplace and to estimate the noise exposure or "dose" received by employees during the workday.

#### WHEN IS IT NECESSARY TO IMPLEMENT A NOISE MONITORING PROGRAM?

It is not necessary for every employer to measure workplace noise. Noise monitoring or measuring must be conducted only when exposures are at or above 85 dB. Factors which suggest that noise exposures in the workplace may be at this level include employee complaints about the loudness of noise, indications that employees are losing their hearing, or noisy conditions which make normal conversation difficult. The employer should also consider any information available regarding noise emitted from specific machines. In addition, actual workplace noise measurements can suggest whether or not a monitoring program should be initiated.

#### HOW IS NOISE MEASURED?

Basically, there are two different instruments to measure noise exposures: the sound level meter and the dosimeter. A sound level meter is a device that measures the intensity of sound at a given moment. Since sound level meters provide a measure of sound intensity at only one point in time, it is generally necessary to take a number of measurements at different times during the day to estimate noise exposure over a workday. If noise levels fluctuate, the amount of time noise remains at each of the various measured levels must be determined.

94

To estimate employee noise exposures with a sound level meter it is also generally necessary to take several measurements at different locations within the workplace. After appropriate sound level meter readings are obtained, people sometimes draw "maps" of the sound levels within different areas of the workplace. By using a sound level "map" and information on employee locations throughout the day, estimates of individual exposure levels can be developed. This measurement method is generally referred to as "area" noise monitoring.

A dosimeter is like a sound level meter except that it stores sound level measurements and integrates these measurements over time, providing an average noise exposure reading for a given period of time, such as an 8-hour workday. With a dosimeter, a microphone is attached to the employee's clothing and the exposure measurement is simply read at the end of the desired time period. A reader may be used to read-out the dosimeter's measurements. Since the dosimeter is worn by the employee, it measures noise levels in those locations in which the employee travels. A sound level meter can also be positioned within the immediate vicinity of the exposed worker to obtain an individual exposure estimate. Such procedures are generally referred to as "personal" noise monitoring.

Area monitoring can be used to estimate noise exposure when the noise levels are relatively constant and employees are not mobile. In workplaces where employees move about in different areas or where the noise intensity tends to fluctuate over time, noise exposure is generally more accurately estimated by the personal monitoring approach.

In situations where personal monitoring is appropriate, proper positioning of the microphone is necessary to obtain accurate measurements. With a dosimeter, the microphone is generally located on the shoulder and remains in that position for the entire workday. With a sound level meter, the microphone is stationed near the employee's head, and the instrument is usually held by an individual who follows the employee as he or she moves about.

Manufacturer's instructions, contained in dosimeter and sound level meter operating manuals, should be followed for calibration and maintenance. To ensure accurate results, it is considered good professional practice to calibrate instruments before and after each use.

#### HOW OFTEN IS IT NECESSARY TO MONITOR NOISE LEVELS?

The amendment requires that when there are significant changes in machinery or production processes that may result in increased noise levels, remonitoring must be conducted to determine whether additional employees need to be included in the hearing conservation program. Many companies choose to remonitor periodically (once every year or two) to ensure that all exposed employees are included in their hearing conservation programs.

#### WHERE CAN EQUIPMENT AND TECHNICAL ADVICE BE OBTAINED?

Noise monitoring equipment may be either purchased or rented. Sound level meters cost about \$500 to \$1,000, while dosimeters range in price from about \$750 to \$1,500. Smaller companies may find it more economical to rent equipment rather than to purchase it. Names of equipment suppliers may be found in the telephone book (Yellow Pages) under headings such as: "Safety Equipment," "Industrial Hygiene," or "Engineers-Acoustical." In addition to providing information on obtaining noise monitoring equipment, many companies and individuals included under such listings can provide professional

99

advice on how to conduct a valid noise monitoring program. Some audiological testing firms and industrial hygiene firms also provide noise monitoring services. Universities with audiology, industrial hygiene, or acoustical engineering departments may also provide information or may be able to help employers meet their obligations under this amendment.

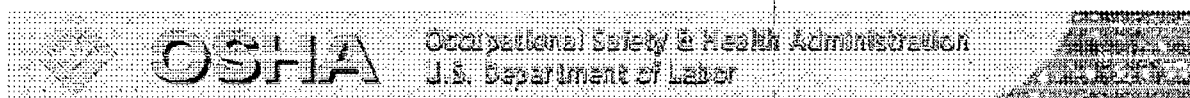
Free, on-site assistance may be obtained from OSHA-supported state and private consultation organizations. These safety and health consultative entities generally give priority to the needs of small businesses.

[61 FR 9227, March 7, 1996]

---

OSHA Regulations (Standards - 29 CFR) - Table of Contents

---



## OSHA Regulations (Standards - 29 CFR)

### Availability of referenced documents - 1910.95 App H

#### OSHA Regulations (Standards - 29 CFR) - Table of Contents

- **Standard Number:** 1910.95 App H
- **Standard Title:** Availability of referenced documents
- **SubPart Number:** G
- **SubPart Title:** Occupational Health and Environmental Control

Paragraphs (c) through (o) of 29 CFR 1910.95 and the accompanying appendices contain provisions which incorporate publications by reference. Generally, the publications provide criteria for instruments to be used in monitoring and audiometric testing. These criteria are intended to be mandatory when so indicated in the applicable paragraphs of 1910.95 and appendices.

It should be noted that OSHA does not require that employers purchase a copy of the referenced publications. Employers, however, may desire to obtain a copy of the referenced publications for their own information.

The designation of the paragraph of the standard in which the referenced publications appear, the titles of the publications, and the availability of the publications are as follows:

Paragraph designation	Referenced publication	Available from --
Appendix B .....	"List of Personal Hearing Protectors and Attenuation Data," HEW Pub. No. 76-120, 1975. NTIS-PB267461.	National Technical Information Service, Port Royal Road, Springfield, VA 22161.
Appendix D .....	"Specification for Sound Level Meters," S1.4-1971 (R1976).	American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.
1910.95(k)(2), Appendix E ...	"Specifications for	American National

Audiometers,"  
S3.6-1969.

Standards  
Institute, Inc.,  
1430 Broadway,  
New York, NY  
10018.

Appendix D ..... "Specification for Octave,  
Half-Octave and  
Third-Octave Band  
Filter Sets,"  
S1.11-1971 (R1976).

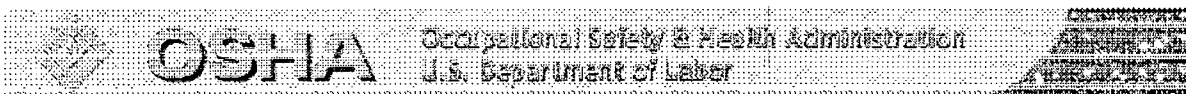
Back Numbers  
Department,  
Dept. STD,  
American  
Institute of  
Physics,  
333 E. 45th St.,  
New York, NY  
10017;  
American National  
Standards  
Institute, Inc.,  
1430 Broadway,  
New York, NY  
10018.

The referenced publications (or a microfiche of the publications) are available for review at many universities and public libraries throughout the country. These publications may also be examined at the OSHA Technical Data Center, Room N2439, United States Department of Labor, 200 Constitution Avenue, NW., Washington, DC 20210, (202) 219-7500 or at any OSHA Regional Office (see telephone directories under United States Government - Labor Department).

[61 FR 9227, March 7, 1996]

4 OSHA Regulations (Standards - 29 CFR) - Table of Contents

102



## OSHA Regulations (Standards - 29 CFR)

### Definitions - 1910.95 App I

#### OSHA Regulations (Standards - 29 CFR) - Table of Contents

- **Standard Number:** 1910.95 App I
- **Standard Title:** Definitions
- **SubPart Number:** G
- **SubPart Title:** Occupational Health and Environmental Control

These definitions apply to the following terms as used in paragraphs (c) through (n) of 29 CFR 1910.95.

**Action level** - An 8-hour time-weighted average of 85 decibels measured on the A-scale, slow response, or equivalently, a dose of fifty percent.

**Audiogram** - A chart, graph, or table resulting from an audiometric test showing an individual's hearing threshold levels as a function of frequency.

**Audiologist** - A professional, specializing in the study and rehabilitation of hearing, who is certified by the American Speech-Language-Hearing Association or licensed by a state board of examiners.

**Baseline audiogram** - The audiogram against which future audiograms are compared.

**Criterion sound level** - A sound level of 90 decibels.

**Decibel (dB)** - Unit of measurement of sound level.

**Hertz (Hz)** - Unit of measurement of frequency, numerically equal to cycles per second.

**Medical pathology** - A disorder or disease. For purposes of this regulation, a condition or disease affecting the ear, which should be treated by a physician specialist.

**Noise dose** - The ratio, expressed as a percentage, of (1) the time integral, over a stated time or event, of the 0.6 power of the measured SLOW exponential time-averaged, squared A-weighted sound

103

pressure and (2) the product of the criterion duration (8 hours) and the 0.6 power of the squared sound pressure corresponding to the criterion sound level (90 dB).  
Noise dosimeter - An instrument that integrates a function of sound pressure over a period of time in such a manner that it directly indicates a noise dose.

Otolaryngologist - A physician specializing in diagnosis and treatment of disorders of the ear, nose and throat.  
Representative exposure - Measurements of an employee's noise dose or 8-hour time-weighted average sound level that the employers deem to be representative of the exposures of other employees in the workplace.

Sound level - Ten times the common logarithm of the ratio of the square of the measured A-weighted sound pressure to the square of the standard reference pressure of 20 micropascals. Unit: decibels (dB). For use with this regulation, SLOW time response, in

accordance with ANSI S1.4-1971 (R1976), is required.  
Sound level meter - An instrument for the measurement of sound level.

Time-weighted average sound level - That sound level, which if constant over an 8-hour exposure, would result in the same noise dose as is measured.

[39 FR 23502, June 27, 1974, as amended at 46 FR 4161, Jan. 16, 1981; 46 FR 62845, Dec. 29, 1981; 48 FR 9776, Mar. 8, 1983; 48 FR 29687, June 28, 1983; 54 FR 24333, June 7, 1989; 61 FR 5507, Feb. 13, 1996; 61 FR 9227, March 7, 1996]

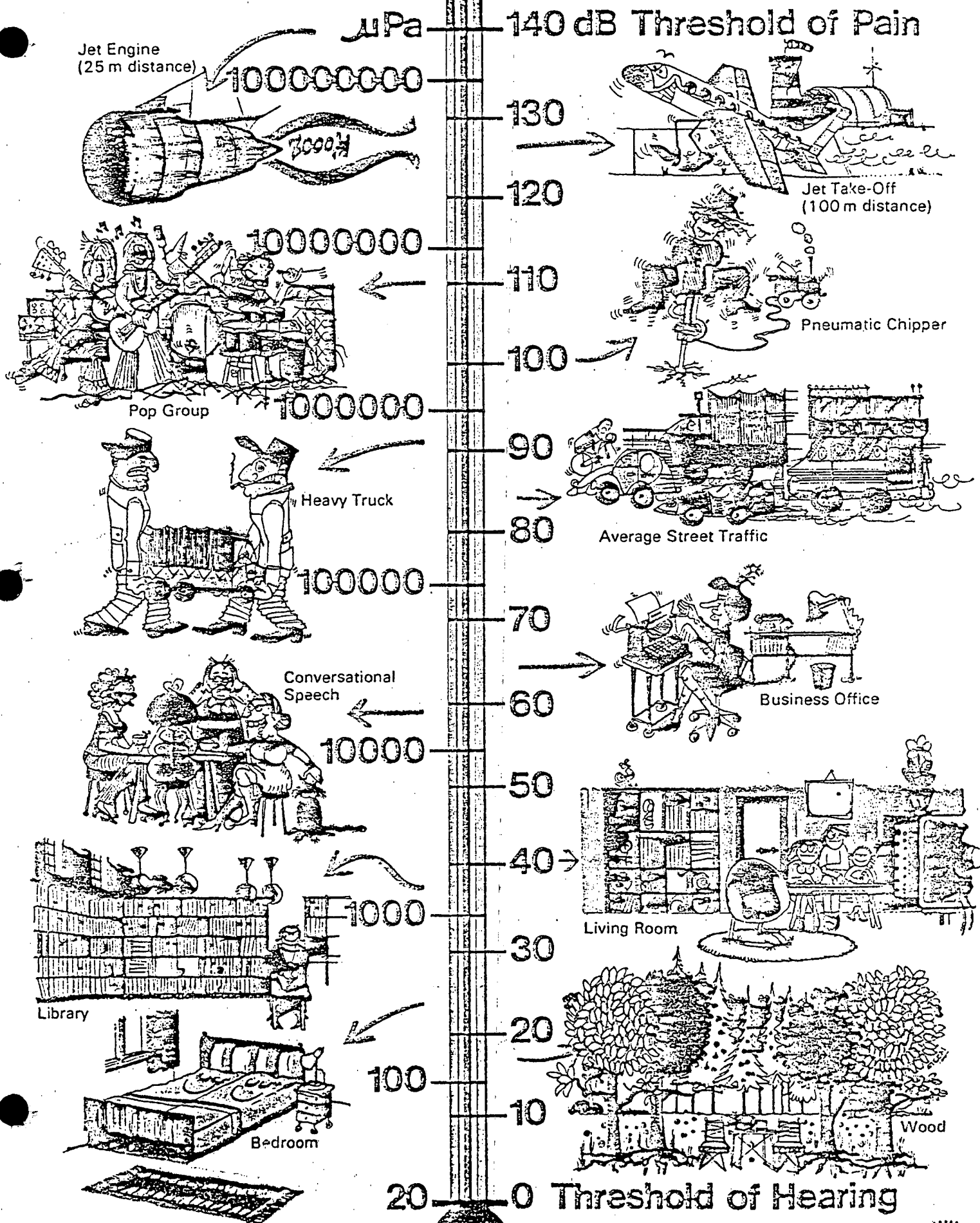
---

OSHA Regulations (Standards - 29 CFR) - Table of Contents

---

# Sound Pressure

# Sound Pressure Level





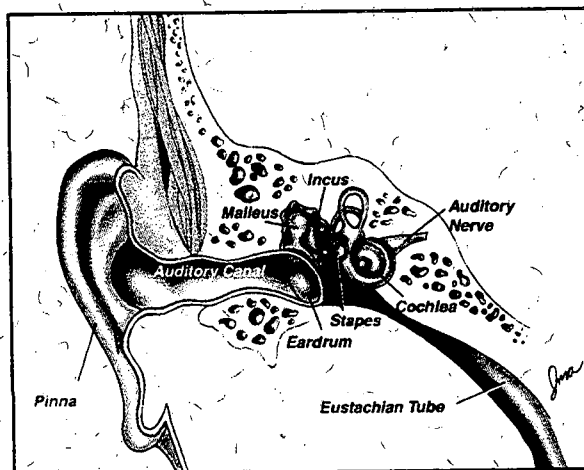
# Noise-Induced Hearing Loss

## What Is Noise-Induced Hearing Loss?

Every day we experience sound in our environment, such as the television, radio, washing machine, automobiles, buses, and trucks. But when an individual is exposed to harmful sounds—sounds that are too loud or loud sounds over a long time—sensitive structures of the inner ear can be damaged, causing Noise-Induced Hearing Loss (NIHL).

## How Do We Hear?

Hearing is a series of events in which the ear converts sound waves into electrical signals and causes nerve impulses to be sent to the brain, where they are interpreted as sound. The ear has three main parts: the outer, middle, and inner ear. Sound waves enter through the outer ear and reach the middle ear, where they cause the eardrum to vibrate. The vibrations are transmitted through three tiny bones in the middle ear called the ossicles. These three bones are named the malleus, incus, and stapes (and are also known as the hammer, anvil, and stirrup). The eardrum and ossicles amplify the vibrations and carry them to the inner ear. The stirrup transmits the amplified vibrations through the oval window and into the fluid that fills the inner ear. The vibrations move through fluid in the snail-shaped hearing part of the inner ear (cochlea) that contains the hair cells. The fluid in the cochlea moves the top portion of the hair cells, called the hair bundle, which initiates the changes that lead to the production of the nerve impulses.



pulses. These nerve impulses are carried to the brain, where they are interpreted as sound. Different sounds move the population of hair cells in different ways, thus allowing the brain to distinguish among various sounds; for example, different vowel and consonant sounds.

## What Sounds Cause NIHL?

NIHL can be caused by a one-time exposure to loud sound as well as by repeated exposure to sounds at various loudness levels over an extended period of time. The loudness of sound is measured in units called decibels. For example, usual conversation is approximately 60 decibels, the humming of a

More than 30 million

Americans are exposed to hazardous sound levels on a regular basis. Individuals of all ages, including children, adolescents, young adults, and older people, can develop NIHL.

(over)

106

refrigerator is 40 decibels, and city traffic noise can be 80 decibels. Examples of sources of loud noises that cause NIHL are motorcycles, firecrackers, and small arms fire, all emitting sounds from 120 to 140 decibels. Sounds of less than 75 decibels, even after long exposure, are unlikely to cause hearing loss.

Exposure to harmful sounds causes damage to the sensitive hair cells of the inner ear and to the nerve of hearing. These structures can be injured by noise in two different ways: from an intense brief impulse, such as an explosion, or from continuous exposure to noise, such as that in a woodworking shop.

### **What Are the Effects of NIHL?**

The effect from impulse sound can be instantaneous and can result in an immediate hearing loss that may be permanent. The structures of the inner ear may be severely damaged. This kind of hearing loss may be accompanied by tinnitus, an experience of sound like ringing, buzzing, or roaring in the ears or head, which may subside over time. Hearing loss and tinnitus may be experienced in one or both ears, and tinnitus may continue constantly or intermittently throughout a lifetime.

The damage that occurs slowly over years of continuous exposure to loud noise is accompanied by various changes in the structure of the hair cells. It also results in hearing loss and tinnitus. Exposure to impulse and continuous noise may cause only a temporary hearing loss. If the hearing recovers, the temporary hearing loss is called a temporary threshold shift. The temporary threshold shift largely disappears within 16 hours after exposure to loud noise.

Both forms of NIHL can be prevented by the regular use of hearing protectors such as earplugs or earmuffs.

### **What Are the Symptoms of NIHL?**

The symptoms of NIHL that occur over a period of continuous exposure increase gradually. Sounds may become distorted or muffled, and it may be difficult for the person to understand speech. The individual may not be aware of the loss, but it can be detected with a hearing test.

### **Who Is Affected by NIHL?**

More than 30 million Americans are exposed to hazardous sound levels on a regular basis. Ten million Americans have suffered irreversible NIHL. Individuals of all ages, including children, adolescents, young adults, and older people, can develop NIHL. Exposure occurs in the workplace, in recreational settings, and at home. There is an increasing awareness of the harmful noises in recreational activities, for example, target shooting or hunting, snowmobiles, go-carts, woodworking and other hobby equipment, power horns, cap guns, and model airplanes. Harmful noises at home may come from vacuum cleaners, garbage disposals, lawn mowers, leaf blowers, and shop tools. People who live in either urban or rural settings may be exposed to noisy devices on a daily basis.

# N I D C D F A C T S H E E T

107

## Can NIHL Be Prevented?

NIHL is preventable. All individuals should understand the hazards of noise and how to practice good hearing health in everyday life.

- Know which noises can cause damage (those above 75 decibels).
- Wear earplugs or other hearing protective devices when involved in a loud activity (special earplugs and earmuffs are available at hardware stores and sporting good stores).
- Be alert to hazardous noise in the environment.
- Protect children who are too young to protect themselves.
- Make family, friends, and colleagues aware of the hazards of noise.
- Have a medical examination by an otolaryngologist, a physician who specializes in diseases of the ears, nose, throat, head, and neck, and a hearing test by an audiologist, a health professional trained to identify and measure hearing loss and to rehabilitate persons with hearing impairments.

## What Research Is Being Done for NIHL?

Scientists focusing their research on the mechanisms causing NIHL hope to understand more fully the internal workings of the ear, which will result in better prevention and treatment strategies. For example, scientists have discovered that damage to the structure of the hair bundle of the hair cell is related to temporary and permanent loss of hearing. They have found that when the hair bundle is exposed to prolonged periods of damaging sound, the basic structure of the hair bundle is destroyed and the important connections among hair cells are disrupted, which directly lead to hearing loss.

Other studies are investigating potential drug therapies that may provide insight into the mechanisms of NIHL. For example, scientists studying altered blood flow in the cochlea are seeking the effect on the hair cells. They have shown reduced cochlear blood flow following exposure to noise. Further research has shown that a drug that promotes blood flow and is used for treatment of peripheral vascular disease (any abnormal condition in blood vessels outside the heart) maintains circulation in the cochlea during exposure to noise. These findings may lead to the development of treatment strategies to reduce NIHL.

Continuing efforts will provide opportunities that can aid research on NIHL as well as other diseases and disorders that cause hearing loss. Research is the way to develop new, more effective methods to prevent, diagnose, treat, and eventually eliminate these diseases and disorders and improve the health and quality of life for all Americans.

■ For more information, contact:  
NIDCD Information Clearinghouse  
1 Communication Avenue  
Bethesda, MD 20892-3456

1-800-241-1044  
1-800-241-1055 (TTY)  
E-mail: [nidcdinfo@nidcd.nih.gov](mailto:nidcdinfo@nidcd.nih.gov)  
Internet: [www.nih.gov/nidcd](http://www.nih.gov/nidcd)

The NIDCD Information Clearinghouse  
is a service of the  
National Institute on Deafness and Other  
Communication Disorders

## **Where Can I Get Additional Information?**

### **American Academy of Audiology**

8201 Greensboro Drive, Suite 300

McLean, VA 22102

(800) AAA-2336 (Toll free)

(703) 610-9022 (Voice/TTY)

[www.audiology.org](http://www.audiology.org)

### **American Academy of Otolaryngology-Head and Neck Surgery**

One Prince Street

Alexandria, VA 22314

(703) 519-1589 (Voice)

(703) 519-1585 (TTY)

[www.entnet.org](http://www.entnet.org)

### **American Auditory Society**

512 East Canterbury Lane

Phoenix, AZ 85022

(602) 789-0755 (Voice)

(602) 942-1486 (Fax)

[www.amauditorysoc.org](http://www.amauditorysoc.org)

### **American Speech-Language-Hearing Association (ASHA)**

10801 Rockville Pike

Rockville, MD 20852

(800) 638-8255 (Toll free)

(301) 897-5700 (Voice/TTY)

[www.asha.org](http://www.asha.org)

### **American Tinnitus Association**

P. O. Box 5

Portland, OR 97207

(800) 634-8978 (Toll free)

[www.ata.org](http://www.ata.org)

### **Self Help for Hard of Hearing People Inc. (SHHH)**

7910 Woodmont Avenue, Suite 1200

Bethesda, MD 20814

(301) 657-2248 (Voice)

(301) 657-2249 (TTY)

[www.shhh.org](http://www.shhh.org)

April 1999

NIH Pub. No. 97-4233

## Worst noise-pollution offenders

Most common noises people complain about:

Industrial or commercial sounds



Aircraft engines



Highway traffic



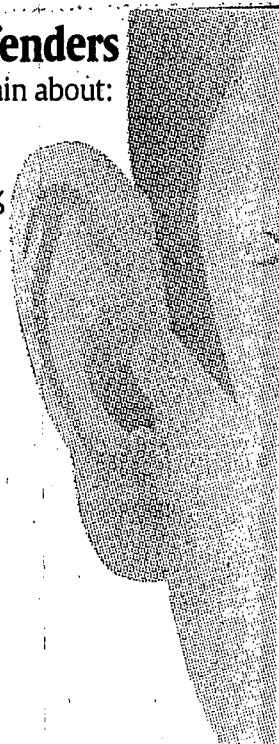
Amplified music



Race track crowds



Source: Noise Pollution Clearinghouse



## How Loud? Some Sound Levels

**A**t home, work and play, noise bombards us and sometimes reaches levels that are not just annoying, but painful and damaging to the ear.

SOUND	DECIBELS
<b>Faint</b>	
Whisper .....	30
<b>Moderate</b>	
Rainfall, air conditioner .....	50
Dishwasher, conversation .....	60
<b>Very loud.</b>	
Heavy traffic, hair dryer .....	70
Weeknight Christmas shopping at Springfield Mall * .....	74-79
"Play Planet," laser tag/video game emporium, Springfield Mall * .....	79
Weeknight rush hour, at K and 23rd Streets, NW * .....	85
Noisiest moments in "Vertical Limit," adventure movie * .....	85-88
Noise at various Metrobus stops* .....	87-89
► AVERAGE NOISE AT REDSKINS GAME .....	89
Truck traffic, shop tools, motorcycle .....	90
Legal limit for three hours of exposure .....	97
<b>Extremely loud</b>	
Printing press, garbage truck, chainsaw .....	100
Slobberbone, rock band at the Iota Club in Arlington* .....	106
Limit above which noise is hazardous within minutes .....	115
<b>Painful</b>	
Jet, thunder, car horn .....	120
Jackhammer .....	130
► CROWD NOISE PROMPTED BY REDSKINS FUMBLES .....	135-137
Gunshot, air raid siren, takeoff of Boeing 747 .....	140
<b>Instantaneously harmful</b>	
► REDSKINS FIREWORKS .....	143
Rocket launch—level at which the sound is so strong that body literally heats up. ....	180

\* From our readings using a hand-held sound-level meter. Other readings come from sources including the NIH, ASHA and various published studies.

## HAVE WISE EARS! FOR LIFE

Protect Yourself and Your Family from  
Noise-Induced Hearing Loss



At Home



At Work

### Who Should Worry About Noise?

Everyone. No matter how old or young you are, too much exposure to loud noise can permanently damage your hearing. Whether it's the screech of a chain saw, the sudden blast of a hunting rifle, or the roar of a lawn mower, exposure to loud sounds can cause Noise-Induced Hearing Loss (NIHL).

NIHL is serious. Some 30 million people are at risk in the workplace, in recreational settings, and at home. In fact, it is the most common work-related disease. Already, 10 million Americans have permanently damaged their hearing.

### What is the WISE EARS! Campaign?

To help prevent NIHL, the National Institute on Deafness and Other Communication Disorders (NIDCD) has teamed with the National Institute for Occupational Safety and Health (NIOSH) and more than 60 diverse national organizations to create the WISE EARS! health education campaign. WISE EARS! is spreading the word that:

- Hearing Matters;
- NIHL is Preventable; and
- WISE EARS! Will Last a Lifetime.

Too Loud

Too Long

Too Close

### How Can I Prevent NIHL and Have WISE EARS! for Life?

No matter what kinds of work and recreation are a part of your life, you can take steps to prevent NIHL.

- Know How Much Noise is Too Much
- Protect Your Hearing in Noisy Environments
- Tell Others How to Prevent NIHL
- Contact WISE EARS! Coalition Members For Assistance

### How Much Noise is Too Much?

Sounds louder than 85 decibels (dB) can damage your ears. A decibel is a unit that measures the intensity of sound on a scale from zero to 140. A normal conversation is about 60 dB. Chainsaws, hammer drills, and bulldozers ring in at over 100 dB. So if you are a construction worker, harmful sounds may be a regular part of your job. The same goes for people working around lawn mowers and factory machinery every day. Airport workers and farmers are two more groups that are regularly exposed to loud noise. However, loud noise does not have to be an everyday happening to cause damage. One-time exposure, such as the sound of a gun firing at close range, can harm your ears permanently.

### How Can I Protect My Hearing in Noisy Situations?

Wear ear plugs or special earmuffs when you are exposed to dangerous levels of noise; they can keep your hearing from being damaged. Hearing protection is important any time you're exposed to loud noise.

### At the WISE EARS! Web site:

- Visit the Kids and Teachers Page
- Play with the Interactive Sound Ruler
- Hear 30-second Radio Spots
- Find Coalition Members
- Explore Classroom Activities
- Watch "What is Sound" (video)
- Get Answers to Hearing Questions
- Read About Coalition Activities

[www.nih.gov/nidcd/health/wise/](http://www.nih.gov/nidcd/health/wise/)



### Where Can I Buy Hearing Protection Devices?

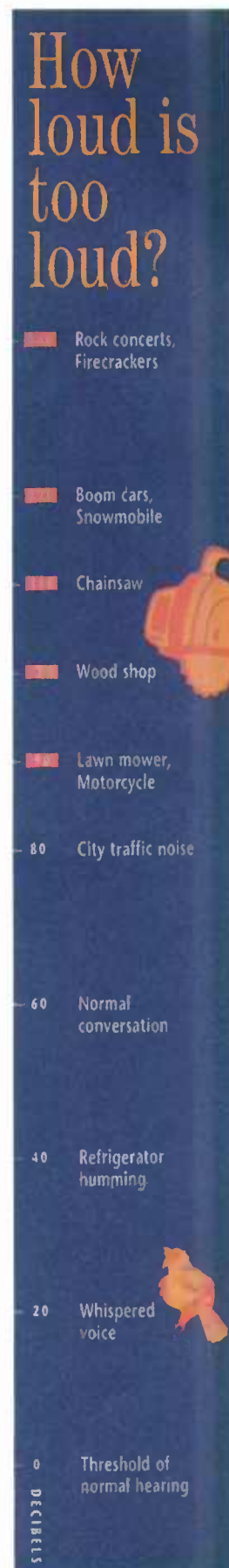
Several different types of protective plugs and muffs are available in most pharmacies, hardware stores, and sporting goods stores.

### What Should I Tell Others About Hearing Protection?

You can share what you know about NIHL with your family, friends, classmates, and co-workers. If you have children, explain to them that hearing is delicate and important. Call their attention to sounds that are harmful. Encourage them to protect their ears by avoiding loud noises or using special ear muffs. If they are too young to protect themselves, do it for them. For your co-workers and other family members, make a copy of this flyer and share what you know about NIHL.

### How Can I Contact WISE EARS! Coalition Members?

Many organizations are committed to preventing NIHL. They can answer questions, offer suggestions, and provide printed or electronic (online) information. Contacting any of the following organizations can be very helpful. Or you may visit the WISE EARS! Web site at [www.nih.gov/nidcd/health/wise/](http://www.nih.gov/nidcd/health/wise/) or call us toll free at (800) 241-1044 for additional addresses and phone numbers.



## Protect your ears

Know which noises  
can cause damage.

Wear ear plugs  
when you are involved  
in a loud activity.

Regular exposure  
of more than  
1 minute risks  
permanent  
hearing loss.

No more  
than 15 minutes  
unprotected  
exposure  
recommended.

Prolonged  
exposure to any  
noise above  
90 decibels can  
cause gradual  
hearing loss.

## Get Sound Advice

For more information  
about hearing loss,  
contact:

NIDCD Information  
Clearinghouse  
1 Communication Avenue  
Bethesda, MD 20892-3456  
1-800-241-1044  
1-800-241-1055 (TTY)  
[www.nih.gov/nidcd](http://www.nih.gov/nidcd)

### **The National Institute for Occupational Safety and Health**

(NIOSH), a Federal agency, offers publications and other information to anyone interested in work-related hearing loss. NIOSH publications focus on both general issues, such as practical guides to preventing hearing loss, and specific issues, such as noise levels in underground coal mines. Call 1-800-35-NIOSH or visit <[www.cdc.gov/niosh](http://www.cdc.gov/niosh)>.

**The National Hearing Conservation Association (NHCA)**, an association of hearing conservation professionals, distributes and exchanges information on NIHL. Call (303) 224-9022 or visit <[www.hearingconservation.org](http://www.hearingconservation.org)>.

**The American Tinnitus Association (ATA)** is a nonprofit group offering services to people with tinnitus (ringing in the ears). Education, information, hearing-health referrals are available. Call 1-800-634-8978 or visit <[www.ata.org](http://www.ata.org)>.

**Hearing Awareness and Education for Rockers (HEAR)** is a nonprofit group dedicated to educating people about the dangers of exposure to loud music. HEAR provides many services, including custom hearing protection, hearing testing, and outreach to increase public awareness. Call (415) 431-3277 or the 24-hour hotline at (415) 773-9590. Visit the Web site at <[www.hearnet.com](http://www.hearnet.com)>.

If you have more questions about NIHL, want a full list of WISE EARS! coalition members, or would like a WISE EARS! information packet, call NIDCD at 1-800-241-1044. NIDCD and the WISE EARS! campaign can also be reached on the Web at:

[www.nih.gov/nidcd/health/wise/](http://www.nih.gov/nidcd/health/wise/)

12/11/00

115

MDE

● Council - advisory  
(reg. &ursions, etc.)

INCR. →

↳ internal to state govt.

Robin Grove, chair

Statutory  
inconstitutions

PP. prep

Real-time analyzer

● Breakfast 4 Oct / 13 Oct.

~~House Keeping~~

Committee (Govt)

First formal mtg

early Feb.

tentative 2/5

(Mon.)

Future  
mtgs

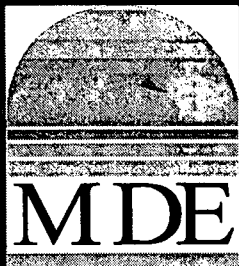
Committee

~~Other Issues~~

major health issue  
= exposure over time  
= guidelines

● Talk about Policy - summary (15 min. max.)  
(Taylor towards issues applicable to group)

## Noise Control Program



---

---

---

---

---

---

---

## Technical & Regulatory Services Administration - Key Staff

- Bob Summers, Director
- Robin Grove, Deputy Director
- George Harman, Program Administrator
- Bill Parrish, Division Chief
- Dave Jarinko, Inspector

---

---

---

---

---

---

---

## Noise Control Program History

- Current Statute References a 1957 statute
- Current law established in 1974 as the Noise Protection Act
- Amendments in: 1982, 1987, 1988, 1991, 1993, 1997
- 1982 Amendment grandfathered gun clubs
- All other amendments - minor

---

---

---

---

---

---

---

## Noise Control Program

- Originally in DHMH until 1987
  - Community Health Program of the Office of Environmental Programs in 1981- 1987
- MDE in 1987
  - Air Management Administration - 1987
  - MDE Waste Management Admin. - 1992
  - MDE Technical and Regulatory Services Admin 1995

---

---

---

---

---

---

---

## Prevention

- Zoning (Master Plans)
- Permitting agency (state, county, local)
- Building Permit Review
- Developers
- Businesses
- Transportation Planning

---

---

---

---

---

---

---

## Elements of the Statute

- Environment Article, Title 3
  - Definitions
  - Statement of Intent
    - Right to an environment that is free from noise that may jeopardize health, general welfare, or property, or degrades the quality of life
    - Work cooperatively with political subdivisions

---

---

---

---

---

---

---

### Responsibilities of the Department

- Develop a plan
- Coordinate all state agency programs
- Maintain records of local programs

---

---

---

---

---

---

---

### Powers of Local Subdivisions

- No standard less stringent than state
- May not prohibit trap shooting, skeet shooting, or other target shooting between 9 am and 10 PM for clubs in operation prior to July 1, 1983 in 14 jurisdictions
  - AL, AA, BC, Calvert, Charles, Garrett, HO, MO, SM, and WA - ok to regulate
- Local programs must be sent to MDE

---

---

---

---

---

---

---

### Noise Advisory Council

- Five members
  - Acoustical Society of America
  - Medical and Chirurgical Faculty
  - University of Maryland System
  - General Public (2)
- Duty - provide advice on any proposed noise standard (60 days)

---

---

---

---

---

---

---

### Interagency Noise Committee

- Governor's Executive Staff
- Dept. of the Environment
- Dept. of Transportation
- Dept. of Natural Resources
- Department of Planning
- Any other department with noise regulations (MOSH) (DHMH?)

---

---

---

---

---

---

---

### Interagency Noise Committee

- Receive reports on progress and problems
- Evaluate efforts
- Review regulations in relation to other environmental laws
- Recommend new rules, regulations, or law

---

---

---

---

---

---

---

### Regulatory Considerations

- Public health, safety, welfare with a margin of safety
- Hearing loss potential
- Interference with sleep
- Adverse psychological responses
- Harm to animal life

---

---

---

---

---

---

---

### Regulatory Considerations

- Devaluation of property value
- Unreasonable interference with the enjoyment of life
- Nature and zoning of affected areas
- Nature and source of noise
- Noise reduction potentials

---

---

---

---

---

---

---

### Regulatory Considerations

- Measurement capabilities
- Cost of compliance
- May not prohibit trap shooting in Fred. Co. where Dept. of Planning & Zoning has approved site
- Heat pumps and air conditioners must be less than 75 dBA and 70 dBA, respectively

→ may be able to remodel w/ better eq. pmt.

---

---

---

---

---

---

---

### Regulatory Considerations

- May not apply to construction or repair on public property, or to fire station alerting
- Administrative Procedures Act must be followed

↳ - should we be exempt. ? (Maybe not)

---

---

---

---

---

---

---



## Enforcement

- Corrective Order
- Injunctive actions - prior notice and reasonable time for compliance
- Civil penalty - up to \$10,000 per day  
– (may return 75%)
- Plan for Compliance - no action while acting under an approved plan

---

---

---

---

---

---

---

## Acts of God

- NOT REGULATED

---

---

---

---

---

---

---

## Noise Regulations

- Preface - restates purpose in statute
- Definitions
- Goals
  - Industrial 70 dBA  $L_{eq}(24)$
  - Commercial 64 dBA  $L_{dn}$
  - Residential 55 dBA  $L_{dn}$

---

---

*Language (existing)  
somewhat improves*

---

---

---

### Maximum Noise Standards

- Industrial
  - Day 75 dBA Night 75 dBA
- Commercial
  - Day 67 dBA Night 62 dBA
- Residential
  - Day 65 dBA Night 55 dBA

Imax's

### Maximum Noise Standards

- Applicable at receiving property
- Construction and demolition standards
  - 90 dBA daytime (7 AM to 10 PM)
- Discrete tones and periodic noises
  - subtract 5 dBA from other maximum stds
  - e.g. gun shots - 60 dBA vs. 65 dBA daytime
- Vibrations - NONE. Applicable at edge of source property

### Exemptions

- Warning devices (vehicle backup sounds)
- Household tools
- Lawn and snow removal equipment
- Agricultural field machinery
- Blasting operations

### Exemptions

- Vehicles on highways (MVA)
- Aircraft (FAA, MAA)
- Boats (DNR)
- Emergency Operations
- Pile driving equipment
- Rail operations
- Air conditioning equipment

*no time restrictions*

### Exemptions

- Non electronically amplified sound from:
  - sporting events
  - amusement parks
  - entertainment
  - locally approved gatherings

### Exemptions

- Non electronically amplified sound from:
  - athletic contests
  - carnivals
  - fairgrounds
  - sanctioned auto racing facilities

## Noise Regulations

- Variances (MDE may grant)
  - Petition to Department
  - 60 days to respond
  - 30 days public notice for public hearing
  - 5-year renewable
- Measurements (receiving property)
- Penalties

---

---

---

---

---

---

---

---

## ISSUES

- Continuous Noises (goals versus standards)
  - 55 dBA maximum vs. 55 dBA  $L_{dn}$
  - applicable to HVAC, rotary kilns
- Highway noises (joint with DOT)
- Gun clubs (grandfather situations)
- Auto Racing facilities (week nights - jet cars)
- Entertainment (7 AM to midnight exempt)

*focus advisory needs*

---

---

---

---

---

---

---

---

## ISSUES

- Rock Concerts (on site patron effects)
- Bars and Restaurants (outdoor music)
- Dumpsters (nighttime emptying)
- Churches (bells and chime music)
- Vibrations (zero threshold, measurement techniques)

*Other issues  
Vibration*

*meas. proceed.  
quant. stds*

*fix lbs mobile aging*

*local. ord. vs. allow.*

*Combnie Council / comm*

---

---

---

---

---

---

---

---

ENVIRONMENTAL NOISE  
ADVISORY COUNCIL  
AND  
INTERAGENCY NOISE  
CONTROL COMMITTEE

December 11, 2000

---

---

---

---

---

---

---

NOISE CONTROL  
PRINCIPLES AND  
PRACTICES

- Characteristics of Noise
- Noise Measurement
- Noise Control Methods
- Regulation of Noise Pollution

---

---

---

---

---

---

---

CHARACTERISTICS OF  
NOISE

- Sound vs. Noise
  - Sound is a wave motion transmitted in air from a vibrating body.
    - Example - loudspeaker - compression of air in waves by speaker cone

---

---

---

---

---

---

---

126

### CHARACTERISTICS OF NOISE

- Noise is unwanted sound.
- Represents how sound is perceived
- Noise causes physical and psychological effects:
  - Pain
  - Hearing loss
  - Annoyance
  - Interrupted speech
  - Interrupted sleep

---

---

---

---

---

---

---

### CHARACTERISTICS OF NOISE

- Sound waves have :
  - Wavelength
  - Frequency
  - Loudness or Sound Pressure Level

---

---

---

---

---

---

---

### CHARACTERISTICS OF NOISE

- Wavelength
  - Longer wavelength sound has lower frequency or pitch
  - Shorter wavelength sound has higher frequency or pitch

---

---

---

---

---

---

---

## CHARACTERISTICS OF NOISE

### - Frequency

- Measured in Hertz (cycles per second )
- Audible range below 20 to 20,000 Hz
  - Music in range of 40 to 15,000 Hz
- Source of non-audible or audible sound can vibrate media other than air
  - Example - rattling windows

---

---

---

---

---

---

---

---

## CHARACTERISTICS OF NOISE

### • Loudness, Intensity or Sound Pressure Level

- Measured in deciBells (dB)
- Ear responds best to middle frequencies
- Weighting used in sound measurement to model ear's response - A-weighting

---

---

---

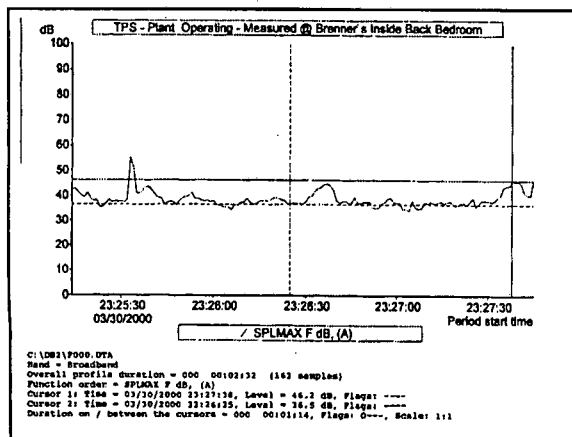
---

---

---

---

---




---

---

---

---

---

---

---

---

126

## NOISE CONTROL METHODS

- Maintain distance from source
- Insulation
- Time of operation
- "Tuning" of source

---

---

---

---

---

---

---

## REGULATION OF NOISE

- Ordinances
- Zoning
- Plan review
- Inspection
- Monitoring
- Technical Assistance
- Enforcement

---

---

---

---

---

---

---



# Maryland Department of the Environment

## Noise Control Program

### Points of Contact

Bob Summers, Director  
Robin Grove, Deputy Director  
410-631-3680

[bsummers@mde.state.md.us](mailto:bsummers@mde.state.md.us)  
[rgrove@mde.state.md.us](mailto:rgrove@mde.state.md.us)

George Harman, Program Manager  
410-631-3856

[gharman@mde.state.md.us](mailto:gharman@mde.state.md.us)

Bill Parrish, Division Chief  
410-631-4164

[bparrish@mde.state.md.us](mailto:bparrish@mde.state.md.us)

Dave Jarinko, Environmental Specialist  
410-631-3991

[djarinko@mde.state.md.us](mailto:djarinko@mde.state.md.us)

130

# **DRAFT MEETING AGENDA**

**Environmental Noise Advisory Council**

**and the**

**Interagency Noise Control Committee**

**December 11, 2000**

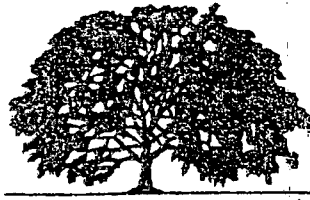
**9:30 AM to 12 Noon**

**Susquehanna Room**

- 9:30 Introductions; Review Agenda .....Robin Grove**
- 9:45 Charge to Council and Committee .....Deputy Secretary Arthur Ray**
- 10:00 Review of Noise Control Principles and Practices.....Bill Parrish**
- 10:45 Break**
- 11:00 Discussion of Noise Control and Regulations.....GeorgeHarman**
- 11:45 Next and Future Meeting Dates.....Robin Grove**

<b>Environmental Noise Advisory Council Appointees</b>	<b>Appointee</b>	<b>Nominated by:</b>
Acoustical Society of America	Ilene Busch-Vishniac, PhD, Dean Whiting School of Engineering Johns Hopkins University 120 New Engineering Bldg. 3400 N. Charles St. Baltimore, MD 21218-2681 (410) 516-8350	Charles E. Schmid, Executive Director Acoustical Society of America Suite 1N01 2 Huntington Quadrangle Melville, NY 11741-4502
Medical & Chirurgical Faculty of Maryland	Stephen Epstein, MD Wheaton Plaza, South Annex 11160 Veirs Mill Road Wheaton, MD 20902 301-949-3800	Karen R. Duszynski, Director Public Health and Physician Quality Programs Medical & Chirurgical Faculty of Maryland 1211 Cathedral Street Baltimore, MD 21201-5516
Chancellor, University System of MD	Fred Schmitz, PhD Dept. of Aerospace Engineering 3181 Martin Hall University of Maryland College Park, MD 20742 301-405-0039	Donald Langenberg, PhD, Chancellor University System of Maryland Elkins Building 3300 Metzerott Road Adelphi, MD 20783-1690
MD State Chamber of Commerce	Michael Powell, Esq. Gordon Feinblatt LLC 233 E. Redwood St. Baltimore, MD 21202-332 410-576-4175	Mitch McCalmon, Vice President for Government Relations Maryland Chamber of Commerce 60 West Street, Suite 100 Annapolis, MD 21401-2479
General public	Nancy Benner 1020 Sumter Avenue Rosedale, MD 21237 410-574-1184	Delegate Jake Mohorovic The Maryland House of Delegates 1947 Midland Road Dundalk, MD 21222

Interagency Noise Control Committee	Appointees	Appointed by:
Governor's Office	Jesse Heier Office of the Governor 410-974-5258 <a href="mailto:jheier@gov.state.md.us">jheier@gov.state.md.us</a>	Jennifer Crawford, Appointments Secretary Executive Department
DNR	Lt. Col. John Fred Sherbert Department of Natural Resources Tawes State Office Building 410-260-8882 <a href="mailto:fsherbert@dnr.state.md.us">fsherbert@dnr.state.md.us</a>	Sara Taylor-Rogers, PhD. Secretary
DHMH	Dr. Robert A. Venezia Department of Health and Mental Hygiene 201. W. Preston St. Baltimore, MD 21201 410-767-5049 <a href="mailto:veneziar@dhmh.state.md.us">veneziar@dhmh.state.md.us</a>	Georges Benjamin, MD, Secretary
DOT	Ken Polcak State Highway Administration Office of Environmental Design 707 N. Calvert Street Baltimore, MD 21202 410-545-8601 <a href="mailto:kpolecak@sha.state.md.us">kpolecak@sha.state.md.us</a>	John D. Porcari, Secretary MDOT
MDE	Robin Grove Technical and Regulatory Services Administration Maryland Department of the Environment 2500 Broening Highway Baltimore, MD 21224 <a href="mailto:rgrove@mde.state.md.us">rgrove@mde.state.md.us</a>	Jane T. Nishida, Secretary
DLLR- MOSH	William Grabau, CIH Maryland Occupational Safety and Health 1100 North Eutaw Street, Room 613 Baltimore MD 21201 410-767-2209 <a href="mailto:william.grabau@osha.gov">william.grabau@osha.gov</a>	Keith Goddard, PhD., Assistant Commissioner MD Occupational Safety and Health Administration



Maryland Department of Transportation  
Better Service \* Better Environment

From the desk of...

**Richard L. Sheckells, Jr.**

11 OCTOBER 2000

KEN -

HERE IS THE BACKGROUND INFO  
ON THE NOISE CONTROL COMMITTEE  
WE DISCUSSED EARLIER THIS WEEK.

GOOD LUCK & THANKS FOR YOUR  
HELP!

Rick

Smart Transportation Solutions



**Maryland Department of Transportation**

The Secretary's Office

134

THE SECRETARY'S OFFICE  
MDOT - SHERRY VARNER - MS 255  
REQUEST FOR PREPARATION OF SECRETARY'S CORRESPONDENCE

LOG DATE: 8/1/00 aac SERIAL#: 17640

TO: Kaiser

DATE: 8/1/00

FROM: Nishida, Jane 7/28/00

RE: Requests support in helping us reconvene the Interagency Noise Control Committee that is described under the Annotated Code of Maryland

RESPOND BY: 8/8/00

~~8/8/00~~  
8/21/00  
per Sherr

**PREPARE RESPONSE FOR SECRETARY'S SIGNATURE**

\_\_\_\_\_  
**FOR USE BY RESPONSIBLE UNIT**

ASSIGN TO: \_\_\_\_\_ DATE: \_\_\_\_\_

TO BE RETURNED TO ADMINISTRATOR'S OFFICE BY: \_\_\_\_\_

SPECIAL INSTRUCTIONS:

\_\_\_\_\_  
**FOR USE BY ASSIGNED AREA**

RESPONSE PREPARED BY: \_\_\_\_\_

(Name / Telephone / Date)

TYPED BY: \_\_\_\_\_

PROOFREAD BY: \_\_\_\_\_

\_\_\_\_\_  
**RECORD OF INTERIM TELEPHONE RESPONSE**

(You can buy yourself some additional time to prepare a written reply by telephoning the constituent, explaining what's happening, and indicating when he/she may expect a formal reply. Please fill this portion and mail back the green sheet to obtain an extension on your reply deadline.)

Name of Person Called: \_\_\_\_\_ DATE: \_\_\_\_\_

Written follow-up will be prepared by: \_\_\_\_\_

\*\*\*\*  
**PLEASE RETURN THIS FORM AND PREPARED CORRESPONDENCE  
TO SHERRY VARNER @ MDOT MS-255**

135

**From:** Rick Sheckells  
**To:** LIZ HOMER  
**Date:** 9/22/00 12:26PM  
**Subject:** Interagency Noise Control Committee

Hi Liz.....

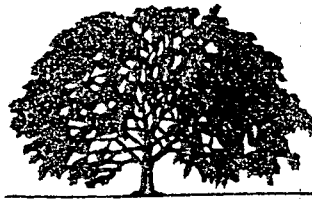
I promised to get back to you following our earlier conversation regarding Secretary Nishida's request of help in reconvening the Interagency Noise Control Committee. At your suggestion, I spoke with Bob Summers, Director of MDE's Technical and Regulatory Services Administration, who's office will be staffing the committee. Bob indicated that the work will be based largely on technical considerations, and that low frequency noise (like power plant sounds) is probably among the bigger issues facing the committee.

Bob is suggesting that individuals with a technical background in noise issues would be valuable to the committee's work. My staff has recommended that SHA probably has better depth in this area than any other mode - including MAA - even though SHA is exempt from most of the requirements. We do not have that technical depth here at HQ.

Please let me know if you can provide someone to be the Secretary's representative on this committee. Bob admitted that this has not been his biggest priority....but that he needs to get moving quickly.

I appreciate your consideration .....any help SHA can provide.

Rick



Maryland Department of Transportation  
Better Service \* Better Environment

From the desk of...

**Richard L. Sheckells, Jr.**

8/4/00

MTK -

LOOKS LIKE TECHNICAL & SOMEWHAT  
TIME INTENSIVE ... REVIEWING/REVISING  
COMAR REGS. 1ST THOUGHT WAS MAA AS  
THE TRANSP REP... BUT MAA HAS CUT BACK  
SERIOUSLY ON NOISE WORK... NOISE DIRECTOR IS  
WORKING AS SPECIAL ASST TO BLACKSHEAR, TECH  
PULSON IS PART TIME, SHA PROBABLY HAS A  
BETTER CHANCE OF DOING THIS WORK... SHA HAS  
THE TECHNICAL SKILLS. APPOINTING SOMEONE  
FROM SHA IS MY RECOMMENDATION. MEG  
COULD DO THIS IF WE WERE TO CONSIDER THE  
COMMITTEE ROLE. (would ~~not~~ not)

DO YOU WANT TO TALK W/ REVERLEY ABOUT  
THIS BEFORE I TALK W/ SHA/PM?

cc ahead + talk w/ SHA - *Richard L. Sheckells, Jr.*  
Smart Transportation Solutions





# MARYLAND DEPARTMENT OF THE ENVIRONMENT

2500 Broening Highway • Baltimore Maryland 21224

(410) 631-3000 • 1-800-633-6101 • <http://www.mde.state.md.us>

Parris N. Glendening  
Governor

Jane T. Nishida  
Secretary

137  
**RECEIVED**

JUL 28 2000

The Honorable John Porcari, Secretary  
Maryland Department of Transportation  
P.O. Box 8755  
BWI Airport MD 21240-0755

JUL 27 2000  
17640  
SECRETARY  
DEPARTMENT OF TRANSPORTATION

Dear Secretary Porcari:

MAISHA KAISER  
Please Prepare Response For Secretary's  
Signature  
cc Beverly Susan Staley

I would like to request your support in helping us reconvene the Interagency Noise Control Committee that is described under the Annotated Code, Environment, Title 3, Noise Control, §§ 3-101 through 3-506 (attached). The State's noise control regulations found in COMAR Title 26.02.03 have not been reviewed or revised since 1983 and a number of important issues have arisen in the past year that need to be addressed by the Committee.

The Annotated Code specifies that the members of the committee be appointed from the list of designated agencies, including yours, by the respective Secretaries or agency heads. Sections 3-303 and 3-304 describe the roles, duties and other specifics regarding Committee membership.

Please provide the name, address, phone number, and email address of your designee for this committee to Dr. Robert Summers, Director, Technical and Regulatory Services Administration. Should you have any questions, or require additional information, please do not hesitate to contact me at 410-631-3084 or Dr. Summers at 410-631-3680.

Sincerely,

Jane T. Nishida  
Secretary

Enclosures

See Distribution List

Distribution List:

The Honorable Walter M. Baker  
The Honorable Larry E. Haines  
The Honorable Philip C. Jimeno  
The Honorable Sharon M. Grosfeld  
The Honorable Jacob J. Mohorovic, Jr.  
The Honorable Dan K. Morhaim  
The Honorable David D. Rudolph  
Robert Summers, Maryland Department of the Environment  
Diane Shaw, Maryland Department of the Environment

## ENVIRONMENT

## § 3-101

## TITLE 3.

## NOISE CONTROL.

## Subtitle 1. Definitions; General Provisions.

## Sec.

## 3-101. Definitions.

- (a) In general.
- (b) Committee.
- (c) Council.
- (d) Environmental noise standard.
- (e) Noise.
- (f) Political subdivision.
- (g) Sound level limit.
- (h) Source.

3-102. Legislative findings and intent.

3-103. Responsibilities of Department.

3-104. Authority to obtain funds.

3-105. Powers and duties of political subdivisions.

## Subtitle 2. Environmental Noise Advisory Council.

3-201. Council established.

3-202. Membership.

3-203. Officers.

3-204. Meetings; compensation; staff.

3-205. Advisory role of Council.

## Subtitle 3. Interagency Noise Control Committee.

3-301. Committee established.

3-302. Composition; chairman.

3-303. Meetings; compensation; staff.

3-304. Duties of Committee.

## Subtitle 4. Rulemaking and Enforcement.

3-401. Environmental noise standards, sound level limits, and noise control rules and regulations — Adoption.

3-402. Same — Procedures for adoption.

3-403. Same — Enforcement.

3-404. Corrective orders.

3-405. Injunctive actions.

3-406. Civil penalty.

3-407. Plan for compliance.

3-408. Conditions not violations.

## Subtitle 1. Definitions; General Provisions.

## § 3-101. Definitions.

(a) *In general*. — In this title the following words have the meanings indicated.

(b) *Committee*. — "Committee" means the Interagency Noise Control Committee.

(c) *Council*. — "Council" means the Environmental Noise Advisory Council.

(d) *Environmental noise standard*. — "Environmental noise standard" means a goal for the limitation of noise, from all sources, that exists in a defined area under specified conditions.

(e) *Noise*. — (1) "Noise" means the intensity, frequency, duration, and character of sound.

(2) "Noise" includes sound and vibration of subaudible frequencies.

(f) *Political subdivision*. — "Political subdivision" means a county or municipal corporation of this State.

(g) *Sound level limit*. — "Sound level limit" means the maximum allowable noise emission from a noise source in a defined area under specified conditions.

(h) *Source*. — "Source" means any person or property from which sound originates. (An. Code 1957, art. 43, § 823; 1982, ch. 240, § 2.)

140

## ENVIRONMENT

## § 3-105

## § 3-104. Authority to obtain funds.

The Department may obtain any federal or other funds that are available to this State for purposes that are within the scope of this title. (An. Code 1967, art. 43, § 831; 1982, ch. 240, § 2.)

## § 3-105. Powers and duties of political subdivisions.

(a) *Power to adopt ordinances, rules, or regulations; limitations on authority.* — (1) Except as provided in this section, this title does not limit the power of a political subdivision to adopt noise control ordinances, rules, or regulations.

(2) A political subdivision may not adopt any noise control ordinance, rule, or regulation that is less stringent than the environmental noise standards, sound level limits, and noise control rules and regulations adopted under this title.

(3) (i) A political subdivision may not adopt any noise control ordinance, rule, or regulation, including the environmental noise standards, sound level limits, and noise control rules and regulations adopted under this title, that prohibits trapshooting, skeetshooting, or other target shooting between the hours of 9 a.m. and 10 p.m. by a shooting sports club that is chartered and in operation as of July 1, 1983. However, this prohibition does not apply if the sports shooting club moves to a parcel of land that is not contiguous to the location of the club on July 1, 1983.

(ii) This paragraph does not apply in Allegany, Anne Arundel, Baltimore City, Calvert, Charles, Garrett, Howard, Montgomery, St. Mary's, and Washington counties.

(b) *Duties.* — Each political subdivision shall:

(1) Send to the Department a copy of each noise control ordinance, rule, or regulation that it adopts; and

(2) Identify on each zoning map, comprehensive plan, or other appropriate document the sound level limits that are adopted under Subtitle 4 of this title. (An. Code 1957, art. 43, §§ 829, 832; 1982, ch. 240, § 2; 1983, ch. 338.)

**Baltimore noise control ordinance violative of federal Constitution.** — A Baltimore noise control ordinance, as applied to the amplification of political speech on public streets, so as to prohibit amplification that created no more noise than a person speaking slightly

louder than normal, was vague and overbroad in violation of the First and Fourteenth Amendments to the federal Constitution. *United States Labor Party v. Pomerleau*, 557 F.2d 410 (4th Cir. 1977).

## § 3-203. Officers.

From among the Council members, the Secretary of the Environment shall appoint a chairman, a vice chairman, and a secretary of the Council. (An. Code 1957, art. 43, § 825; 1982, ch. 240, § 2; 1987, ch. 306, § 15; 1988, ch. 6, § 11.)

## § 3-204. Meetings; compensation; staff.

(a) *Meetings.* — The Council shall meet at the times and places that the Secretary or the chairman determines.

(b) *Compensation and reimbursement for expenses.* — A member of the Council:

(1) May not receive compensation; but

(2) Is entitled to reimbursement for expenses under the Standard State Travel Regulations, as provided in the State budget.

(c) *Staff.* — The Department shall provide the Council with secretarial and stenographic assistance. (An. Code 1957, art. 43, § 825; 1982, ch. 240, § 2.)

## § 3-205. Advisory role of Council.

(a) *Duty of Department.* — Before the Department adopts any environmental noise standard or sound level limit, the Department shall submit the proposed environmental noise standard or sound level limit to the Council for advice.

(b) *Duty of Council.* — Within 60 days after receiving a proposed environmental noise standard or sound level limit from the Department, the Council shall give the Department its advice on the proposal by recommending:

(1) Adoption;

(2) Rejection; or

(3) Modification. (An. Code 1957, art. 43, §§ 825, 828; 1982, ch. 240, § 2.)

University of Baltimore Law Review. — land: A Current Assessment," see 3 U. Balt. L. For article, "Preservation of Maryland Farm- Rev. 429 (1979).

*Subtitle 3. Interagency Noise Control Committee.*

## § 3-301. Committee established.

There is an Interagency Noise Control Committee. (An. Code 1957, art. 43, § 827; 1982, ch. 240, § 2.)

142

## ENVIRONMENT

## § 3-401

(b) *Annual report.* — If the Council requests, the annual report of the Committee shall include a report of the Council. (An. Code 1957, art. 43, § 327; 1982, ch. 240, § 2; 1991, ch. 55, § 6; 1992, ch. 432; 1993, ch. 4, § 2.)

*Subtitle 4. Rulemaking and Enforcement.*

§ 3-401. Environmental noise standards, sound level limits, and noise control rules and regulations — Adoption.

(a) *Duty of Department.* — Except as otherwise provided by law, the Department shall adopt environmental noise standards, sound level limits, and noise control rules and regulations as necessary to protect the public health, the general welfare, and property.

(b) *Environmental noise standards.* — In adopting environmental noise standards, the Department shall consider:

(1) Information published by the Administrator of the United States Environmental Protection Agency on the levels of environmental noise that must be attained and maintained in defined areas under various conditions to protect public health and welfare with an adequate margin of safety; and

(2) Scientific information about the volume, frequency, duration, and other characteristics of noise that may harm public health, safety, or general welfare, including:

(i) Temporary or permanent hearing loss;

(ii) Interference with sleep, speech communication, work, or other human activities;

(iii) Adverse physiological responses;

(iv) Psychological distress;

(v) Harm to animal life;

(vi) Devaluation of or damage to property; and

(vii) Unreasonable interference with the enjoyment of life or property.

(c) *Sound level limits; noise control rules and regulations; exceptions.* —

(1) In adopting sound level limits and noise control rules and regulations, the Department shall consider, among other things:

(i) The residential, commercial, or industrial nature of the area affected;

(ii) Zoning;

(iii) The nature and source of various kinds of noise;

(iv) The degree of noise reduction that may be attained and maintained using the best available technology;

(v) Accepted scientific and professional methods for measurement of sound levels; and

(vi) The cost of compliance with the sound level limits.

(2) The sound level limits adopted under this subsection shall be consistent with the environmental noise standards adopted by the Department.

(3) The sound level limits and noise control rules and regulations adopted under this subsection may not prohibit trapshooting or other target shooting

143

## ENVIRONMENT

## § 3-404

(c) *Notice*. — (1) At least 60 days before the public hearing, the Department shall publish notice of the hearing in a newspaper of general circulation within the area concerned.

(2) The notice shall state:

- (i) The date, time, and place of the hearing; and
- (ii) The purpose of the hearing.

(d) *Public inspection*. — At least 60 days before the public hearing, the Department shall make the proposed environmental noise standard, sound level limit, or noise control rule or regulation available to the public.

(e) *Action after hearing*. — After the public hearing, the Department may adopt the proposed environmental noise standard, sound level limit, or noise control rule or regulation, with or without modification. (An. Code 1957, art. 43, § 828; 1982, ch. 240, § 2.)

University of Baltimore Law Review. — land: A Current Assessment," see 8 U. Balt. L. Rev. 429 (1979).  
For article, "Preservation of Maryland Farm-

## § 3-403. Same — Enforcement.

(a) *Duty of Department*. — The Department shall enforce the sound level limits and noise control rules and regulations adopted under this title.

(b) *Use of agency facilities and services*. — To the maximum extent possible, the Department shall use the facilities and services of appropriate agencies of political subdivisions in its enforcement under this section.

(c) *Assistance to political subdivisions*. — The Department may assist the noise control efforts of any appropriate agency of any political subdivision by giving that agency technical assistance in the form of personnel or equipment.

(d) *Application of sound level limits*. — Each sound level limit shall be applied at the boundary of:

- (1) A property; or

(2) A land use category, as determined by the Department. (An. Code 1957, art. 43, § 828; 1982, ch. 240, § 2.)

University of Baltimore Law Review. — land: A Current Assessment," see 8 U. Balt. L. Rev. 429 (1979).  
For article, "Preservation of Maryland Farm-

## § 3-404. Corrective orders.

If the Department determines that there is a violation of this title or any sound level limit or noise control rule or regulation adopted under this title, the Department, after notice to the alleged violator, may issue a corrective order. (An. Code 1957, art. 43, §§ 828, 830; 1982, ch. 240, § 2.)

University of Baltimore Law Review. — land: A Current Assessment," see 8 U. Balt. L. Rev. 429 (1979).  
For article, "Preservation of Maryland Farm-

144

ENVIRONMENT

§ 3-408

§ 3-408. Conditions not violations.

A condition that is caused by an act of God, a strike, a riot, a catastrophe, or a cause over which an alleged violator has no control is not a violation of this title or any rule or regulation adopted under this title. (An. Code 1957, art. 43, § 830; 1982, ch. 240, § 2.)



## § 3-202

## ENVIRONMENT

## TITLE 3.

## NOISE CONTROL.

*Subtitle 2. Environmental Noise  
Advisory Council.*

Sec.  
3-202. Membership.

*Subtitle 4. Rulemaking and Enforcement.*

3-401. Environmental noise standards, sound  
level limits, and noise control rules  
and regulations — Adoption.

*Subtitle 5. Duties and Authority of Units of  
State Government.*

Sec.  
3-501. "Unit" defined.  
3-502. Support of State noise control policy.  
3-503. Compliance with noise control require-  
ments.  
3-504. Sound level limits or regulations.  
3-505. Investigation of complaints.  
3-506. Representatives on Interagency Noise  
Control Committee.

*Subtitle 2. Environmental Noise Advisory Council.*

## § 3-202. Membership.

(a) *Composition; appointment of members.* — (1) The Council consists of 5 members appointed by the Secretary.

(2) Of the 5 Council members:

(i) 1 shall be appointed from a list of at least 3 qualified individuals submitted to the Secretary by the Acoustical Society of America;

(ii) 1 shall be a physician who specializes in hearing, appointed from a list of at least 3 qualified individuals submitted to the Secretary by the Medical and Chirurgical Faculty of the State of Maryland;

(iii) 1 shall be appointed from a list of at least 3 qualified individuals submitted to the Secretary by the Chancellor of the University System of Maryland; and

(iv) 2 shall be appointed from the general public.

(3) Before appointing the members from among the general public, the Secretary shall request and consider suggestions for nominees from:

(i) The Maryland State Chamber of Commerce;

(ii) The Maryland Transportation Federation;

(iii) The Maryland Environmental Trust; and

(iv) Any other environmental groups that the Secretary selects.

(4) In making any appointment to the Council, the Secretary shall consider giving appropriate representation to the various geographical areas of this State.

(b) *Qualifications.* — Each member of the Council shall be a resident of this State.

(c) *Tenure; vacancies.* — (1) The term of a member is 5 years.

(2) The terms of members are staggered as required by the terms provided for members of the Council on July 1, 1982. The terms of those members end as follows:

(i) 1 in 1983;

(ii) 1 in 1984;

(iii) 1 in 1985;

(iv) 1 in 1986; and

## § 3-501

## ENVIRONMENT

146

(vi) The cost of compliance with the sound level limits.

(2) The sound level limits adopted under this subsection shall be consistent with the environmental noise standards adopted by the Department.

(3) The sound level limits and noise control rules and regulations adopted under this subsection may not prohibit trapshooting or other target shooting on any range or other property in Frederick County that the Frederick County Department of Planning and Zoning has approved as a place for those sporting events.

(4) The sound level limits and noise control rules and regulations adopted under this subsection shall be as follows for residential heat pumps and air conditioning units:

(i) Residential heat pumps

75dba.

(ii) Residential air conditioning units

70dba.

(5) (i) The sound level limits and noise control rules and regulations adopted under this subsection may not prohibit trapshooting, skeetshooting, or other target shooting between the hours of 9 a.m. and 10 p.m. on any range or other property of a shooting sports club that is chartered and in operation as of July 1, 1983. However, this prohibition does not apply if the sports shooting club moves to a parcel of land that is not contiguous to the location of the club on July 1, 1983.

(ii) This paragraph does not apply in Allegany, Anne Arundel, Baltimore City, Calvert, Charles, Garrett, Howard, Montgomery, St. Mary's, and Washington Counties.

(d) *Exceptions.* — (1) This section does not authorize the Department to adopt environmental noise standards, sound level limits, or noise control rules and regulations that apply to noise from:

(i) Construction or repair work on public property; or

(ii) Fire or rescue station alerting devices.

(2) Noise control rules and regulations that apply to Department of Transportation facilities shall be adopted jointly by the Department of Transportation and the Department of the Environment. (An. Code 1957, art. 43, §§ 823, 824, 828, 830; 1982, ch. 240, § 2; ch. 527; 1983, ch. 338; 1987, ch. 306, § 16; 1988, ch. 6, § 11; 1997, ch. 14, § 1.)

*Effect of amendments.* — The 1997 amendment, approved Apr. 9, 1997, and effective from date of enactment, substituted a period for a semicolon in (c) (4) (i).

*Subtitle 5. Duties and Authority of Units of State Government.*

§ 3-501. "Unit" defined.

In this subtitle, "unit" means a unit of the State government. (1997, ch. 31, § 1.)

REVISOR'S NOTE

This section is new language added for brevity to avoid excessive repetition throughout this subtitle of the phrase "unit of State government".

**§ 3-505****ENVIRONMENT****§ 3-505. Investigation of complaints.**

A unit that enforces a regulation concerning noise may:

- (1) Investigate a complaint concerning noise;
- (2) Institute and conduct a survey and testing program concerning noise;
- (3) Test or make another determination of the source of a noise; and
- (4) Assess the degree of required abatement of the noise. (An. Code 1957, art. 41, § 1-401; 1997, ch. 31, § 1.)

**REVISOR'S NOTE**

This section is new language derived without substantive change from former Art. 41, § 1-401(d).

In paragraphs (1) and (2) of this section, the reference to "concerning noise" is added for

clarity to avoid any implication that the authority of a unit under these paragraphs applies to situations not involving noise.

**§ 3-506. Representatives on Interagency Noise Control Committee.**

A unit that prescribes or enforces a regulation concerning noise shall designate a representative to serve on the Interagency Noise Control Committee. (An. Code 1957, art. 41, § 1-401; 1997, ch. 31, § 1.)

**REVISOR'S NOTE**

This section is new language derived without substantive change from former Art. 41, § 1-401(e).

**Cross references.** — See Editor's note to § 3-501 of this article.

MESSAGE CONFIRMATION

148  
AUG-15-00 16:17

FAX NUMBER : 410-850-9263

NAME : MDOT MBE/OSPE

FAX NUMBER : 4102095009

PAGE : 01

ELAPSED TIME : 00'38"

MODE : G3 STD

RESULTS : O.K

Faxed to:  
Liz Homer



## MARYLAND DEPARTMENT OF THE ENVIRONMENT

2500 Broening Highway • Baltimore Maryland 21224  
(410) 631-3000 • 1-800-633-6101 • <http://www.mde.state.md.us>

Parris N. Glendening  
Governor

Jane T. Nishida  
Secretary

NOV 27 2000

Mr. Ken Polcak  
State Highway Administration  
Office of Environmental Design  
707 North Calvert Street  
Baltimore MD 21202

Dear Mr. Polcak:

The purpose of this letter is to welcome you as a member of the Interagency Noise Control Committee (Interagency Committee) and invite you to attend its first meeting on December 11, 2000.

The State's noise control regulations, found in the Code of Maryland Regulations (COMAR) Title 26.02.03, have not been comprehensively reviewed since their establishment in 1975. There are a number of important issues and several proposed amendments to the rules that need to be addressed. The authorizing statute, Environment Article, Title 3, Subtitle 2, Noise Control Program, specifically requires that a six member Interagency Committee be convened to assist the Department in monitoring the compliance and implementation of noise standards or sound level limits by various State cabinet-level Departments. The statute specifies that one member of this Committee be appointed by the Secretaries of the Departments of the Environment, Natural Resources, Transportation, Planning, and any other principal department that develops, adopts, or enforces any noise control rule or regulation. I recently requested nominations from the Secretaries of these Departments for service on the Interagency Committee. You were appointed by Secretary John D. Porcari to serve on the Committee as a representative of the Department of Transportation. The attached table identifies the agencies and individuals receiving appointments to the Committee in addition to you.

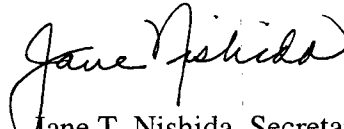
The statute also provides for the establishment of an Environmental Noise Advisory Council (Council). The attached table identifies the organizations involved and the individuals recently appointed by the Secretary to the Council. As the Council and the Committee have not met for some time, and because the issues and proposed regulatory amendments are of concern to both groups, we have decided to have both groups work together to consider the issues before us at this time. The initial meeting of the two groups will be held on December 11, 2000 from 9:30 to noon in the Susquehanna Conference Room. Enclosed are directions to our offices here at 2500 Broening Highway.

150

Mr. Ken Polcak  
Page 2

We appreciate your willingness to serve on the Committee and look forward to meeting with you in December. In addition to the items mentioned above, we have enclosed a tentative agenda for the meeting and copies of relevant background materials. If you have any questions or need additional information please call Mr. William Parrish at (410) 631-4164 or email him at bparrish@mde.state.md.us.

Sincerely,

  
Jane T. Nishida, Secretary

Enclosures



**Maryland Department of Transportation**  
The Secretary's Office

**Parris N. Glendening**  
Governor


**Kathleen Kennedy Townsend**  
Lt. Governor

**John D. Porcari**  
Secretary

**Beverley K. Swalm-Staley**  
Deputy Secretary

**MEMORANDUM**

**TO:** The Honorable Jane Nishida  
Secretary  
Maryland Department of the Environment

**FROM:** John D. Porcari   
Secretary

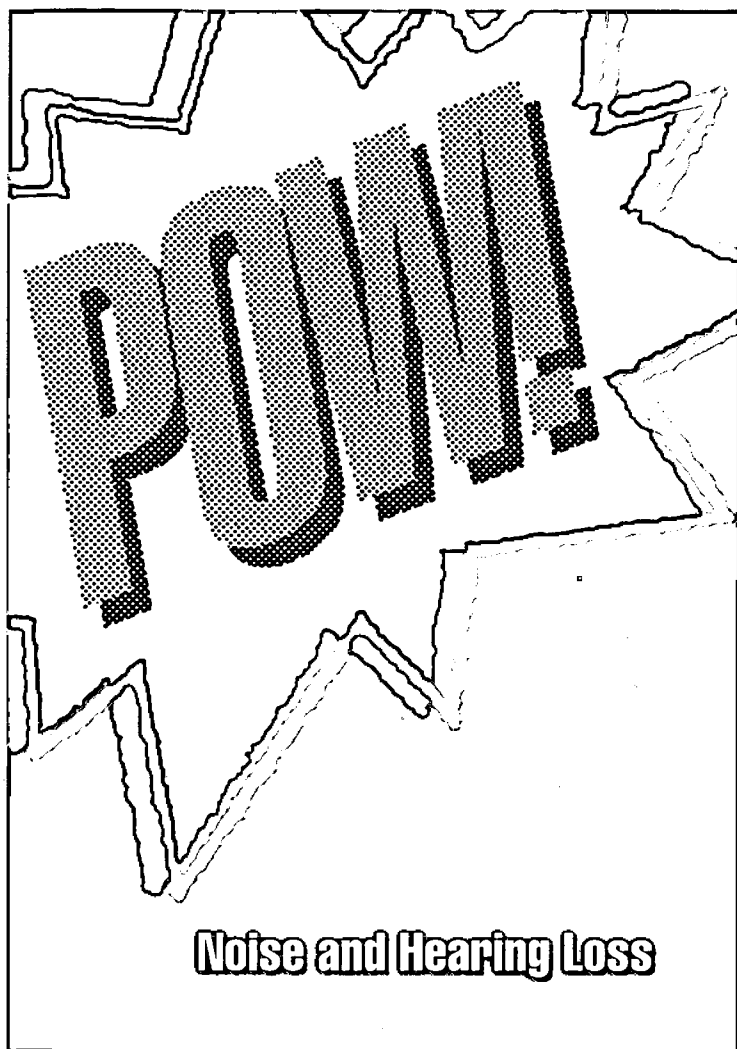
**DATE:** October 18, 2000

**SUBJECT:** Interagency Noise Control Committee

This responds to your July 28 letter requesting support in reconvening the Interagency Noise Control Committee. After discussions with Dr. Robert Summers the issues likely to be considered by the Committee, I am appointing Mr. Ken Polcak as the representative of the Maryland Department of Transportation, in accordance with Title 3 of the Annotated Code.

Mr. Polcak is with the State Highway Administration's Office of Environmental Design, and has dealt with a range of noise control issues for the Department. I am confident that his participation will be helpful to you. You may reach Mr. Polcak directly at 410-545-8601.

cc: Mr. Ken Polcak, Office of Environmental Design, State Highway Administration  
Mr. Robert Summers, Maryland Department of the Environment  
Mr. Parker F. Williams, Administrator, State Highway Administration



## ***Consensus Statement***

NIH Consensus Development Conference  
January 22-24, 1990

Volume 8, Number 1





# ***Consensus Statement***

NIH Consensus Development Conference  
January 22-24, 1990

Volume 8, Number 1

*NIH Consensus Development Conferences are convened to evaluate available scientific information and resolve safety and efficacy issues related to a biomedical technology. The resultant NIH Consensus Statements are intended to advance understanding of the technology or issue in question and to be useful to health professionals and the public.*

*NIH Consensus Statements are prepared by a nonadvocate, non-federal panel of experts, based on: (1) presentations by investigators working in areas relevant to the consensus question during a 1-1/2 day public session; (2) questions and statements from conference attendees during open discussion periods that are part of the public session; and (3) closed deliberations by the panel during the remainder of the second day and morning of the third. This statement is an independent report of the panel and is not a policy statement of the NIH or the Federal Government.*

*Copies of this statement and bibliographies prepared by the National Library of Medicine are available from the Office of Medical Applications of Research, National Institutes of Health, Building 1, Room 260, Bethesda, MD 20892.*

*For making bibliographic reference to the consensus statement from this conference, it is suggested that the following format be used, with or without source abbreviations, but without authorship attribution:*

*Noise and Hearing Loss. NIH Consens Dev Conf Consens Statement 1990 Jan 22-24; 8(1).*

## ABSTRACT

*The National Institutes of Health Consensus Development Conference on Noise and Hearing Loss brought together biomedical and behavioral scientists, health care providers, and the public to address the characteristics of noise-induced hearing loss, acoustic parameters of hazardous noise exposure, individual and age-specific susceptibility, and prevention strategies. Following a day and a half of presentations by experts and discussion by the audience, a consensus panel weighed the evidence and prepared a consensus statement.*

*Among their findings, the panel concluded that sounds of sufficient intensity and duration will damage the ear and result in temporary or permanent hearing loss at any age. Sound levels of less than 75 dB(A) are unlikely to cause permanent hearing loss, while sound levels above 85 dB(A) with exposures of 8 hours per day will produce permanent hearing loss after many years. Current scientific knowledge is inadequate to predict that any particular individual will be safe when exposed to a hazardous noise. Strategies to prevent damage from sound exposure should include the use of individual hearing protection devices, education programs beginning with school-age children, consumer guidance, increased product noise labeling, and hearing conservation programs for occupational settings.*

*The full text of the consensus panel's statement follows.*

## INTRODUCTION

Hearing loss afflicts approximately 28 million people in the United States. Approximately 10 million of these impairments are at least partially attributable to damage from exposure to loud sounds. Sounds that are sufficiently loud to damage sensitive inner ear structures can produce hearing loss that is not reversible by any presently available medical or surgical treatment. Hearing impairment associated with noise exposure can occur at any age, including early infancy, and is often characterized by difficulty in understanding speech and the potentially troublesome symptom, tinnitus (i.e., ringing in the ears). Very loud sounds of short duration, such as an explosion or gunfire, can produce immediate, severe, and permanent loss of hearing. Longer exposure to less intense but still hazardous sounds, commonly encountered in the workplace

or in certain leisure time activities, exacts a gradual toll on hearing sensitivity, initially without the victim's awareness. More than 20 million Americans are exposed on a regular basis to hazardous noise levels that could result in hearing loss. Occupational noise exposure, the most common cause of noise-induced hearing loss (NIHL), threatens the hearing of firefighters, police officers, military personnel, construction and factory workers, musicians, farmers, and truck drivers, to name a few. Live or recorded high-volume music, recreational vehicles, airplanes, lawn-care equipment, woodworking tools, some household appliances, and chain saws are examples of nonoccupational sources of potentially hazardous noise. One important feature of NIHL is that it is preventable in all but certain cases of accidental exposure. Legislation and regulations have been enacted that spell out guidelines for protecting workers from hazardous noise levels in the workplace and consumers from hazardous noise during leisure time pursuits. Inconsistent compliance and spotty enforcement of existing governmental regulations have been the underlying cause for their relative ineffectiveness in achieving prevention of NIHL. A particularly unfortunate occurrence was the elimination of the Office of Noise Abatement and Control within the Environmental Protection Agency in 1982.

On January 22-24, 1990, the National Institute on Deafness and Other Communication Disorders, together with the Office of Medical Applications of Research of the National Institutes of Health convened a Consensus Development Conference on Noise and Hearing Loss. Cosponsors of the conference were the National Institute of Child Health and Human Development, the National Institute on Aging, and the National Institute for Occupational Safety and Health of the Centers for Disease Control. The effects of environmental sounds on human listeners may include:

- Interference with speech communication and other auditory signals.
- Annoyance and aversion.
- Noise-induced hearing loss.
- Changes in various body systems.
- Interference with sleep.

This conference was entirely centered on NIHL. The panel focused on five questions related to noise and hearing loss:

- What is noise-induced hearing loss?
- What sounds can damage hearing?
- What factors, including age, determine an individual's susceptibility to noise-induced hearing loss?
- What can be done to prevent noise-induced hearing loss?
- What are the directions for future research?

Following a day and a half of presentations by experts in the relevant fields and discussion from the audience, a consensus panel comprising specialists and generalists from the medical and other related scientific disciplines, together with public representatives, considered the evidence and formulated a consensus statement in response to the five previously stated questions.

## **WHAT IS NOISE-INDUCED HEARING LOSS?**

Sounds of sufficient intensity and duration will damage the ear and result in temporary or permanent hearing loss. The hearing loss may range from mild to profound and may also result in tinnitus. The effect of repeated sound overstimulation is cumulative over a lifetime and is not currently treatable. Hearing impairment has a major impact on one's communication ability and even mild impairment may adversely affect the quality of life. Unfortunately, although NIHL is preventable, our increasingly noisy environment places more and more people at risk.

### **Studies of NIHL**

Most studies of the association between sound exposure and hearing loss in humans are retrospective measurements of the hearing sensitivities of numerous individuals correlated with their noise exposures. The variability within these studies is usually large; thus, it is difficult to predict the precise magnitude of hearing loss that will result from a specific sound exposure. Prospective studies of selected workers' hearing levels over a long time while their sound exposures are carefully monitored are costly and time-consuming and, due to attrition, require a large number of subjects. When significant hearing loss is found, for ethical reasons, exposures must be reduced, interfering with the relationships under study. Although studies of NIHL in humans are difficult, they provide valuable information not available from animal studies and should be continued.

In prospective animal studies, sound exposures can be carefully controlled, and the anatomic and physiologic correlates of NIHL can be precisely defined. Although there may be interspecies differences with respect to the absolute sound exposure that will injure the ear, the basic mechanisms that lead to damage appear to be similar in all mammalian ears.

### **Anatomic and Physiologic Correlates of NIHL**

Two types of injury are recognized: acoustic trauma and NIHL. Short-duration sound of sufficient intensity (e.g., a gunshot or explosion) may result in an immediate, severe, and permanent hearing loss, which is termed acoustic trauma. Virtually all of the structures of the ear can be damaged, in particular the organ of Corti, the delicate sensory structure of the auditory portion of the inner ear (cochlea), which may be torn apart.

Moderate exposure may initially cause temporary hearing loss, termed temporary threshold shift (TTS). Structural changes associated with TTS have not been fully established but may include subtle intracellular changes in the sensory cells (hair cells) and swelling of the auditory nerve endings. Other potentially reversible effects include vascular changes, metabolic exhaustion, and chemical changes within the hair cells. There is also evidence of a regional decrease in the stiffness of the stereocilia (the hair bundles at the top of the hair cells), which may recover. This decrease in stereocilia stiffness may lead to a decrease in the coupling of sound energy to the hair cells, which thereby alters hearing sensitivity.

Repeated exposure to sounds that cause TTS may gradually cause permanent NIHL in experimental animals. In this type of injury, cochlear blood flow may be impaired, and a few scattered hair cells are damaged with each exposure. With continued exposure, the number of damaged hair cells increases. Although most structures in the inner ear can be harmed by excessive sound exposure, the sensory cells are the most vulnerable. Damage to the stereocilia is often the first change, specifically, alteration of the rootlet structures that normally anchor the stereocilia into the top of the hair cell. Once destroyed, the sensory cells are not replaced. During the recovery period between some sound exposures, damaged regions of the organ of Corti heal by scar formation. This process is very important because it reestablishes the barrier between the two fluids of the inner ear (perilymph and endolymph). If this barrier is not reestablished, degeneration of hair cells may continue. Further, once a sufficient number of hair cells are lost, the nerve fibers to that region also degenerate. With degeneration of the cochlear nerve fibers, there is corresponding degeneration within the central nervous system. The extent to which these neural changes contribute to NIHL is not clear.

With moderate periods of exposure to potentially hazardous high frequency sound, the damage is usually confined to a restricted area in the high-frequency region of the cochlea. With a comparable exposure to low-frequency noise, hair cell damage is not confined to the low-frequency region but may also affect the high-frequency regions. The predominance of damage in different cochlear regions with different frequency exposures reflects factors such as the resonance of the ear

canal, the middle ear transfer characteristics, and the mechanical characteristics of the organ of Corti and basilar membrane.

### **Assessment of NIHL**

Hearing loss is measured by determining auditory thresholds (sensitivity) at various frequencies (pure-tone audiometry). Complete assessment should also include measures of speech understanding and middle-ear status (immittance audiometry). Pure-tone audiometry is also used in industrial hearing conservation programs to determine whether adequate protection against hazardous sound levels is provided.

The first audiometric sign of NIHL resulting from broadband noise is usually a loss of sensitivity in the higher frequencies from 3,000 through 6,000 Hertz (Hz) (i.e., cycles per second), resulting in a characteristic audiometric "notch." With additional hearing loss from noise or aging, the threshold at 8,000 Hz may worsen and eliminate this characteristic audiometric pattern. Thus, the presence or absence of NIHL cannot be established on the basis of audiometric shape, per se. The hearing loss is usually bilateral, but some degree of asymmetry is not unusual, especially with lateralized noise sources such as rifles. After moderate sound exposure, TTS may occur, and, during a period of relative quiet, thresholds will return to normal levels. If the exposure continues on a regular basis, permanent threshold shifts (PTS) will result, increasing in magnitude and extending to lower and higher frequencies. If the exposures continue, NIHL increases, more rapidly in the early years. After many years of exposure, NIHL levels off in the high frequencies, but continues to worsen in the low frequencies. Although TTS and PTS are correlated, the relation is not strong enough to use TTS to predict the magnitude of permanent hearing loss.

An important consequence of the sensitivity loss associated with NIHL is difficulty in understanding speech. Whereas a large proportion of the *energy* in speech is contained within the low frequency range, much of the *information* required to differentiate one speech sound from another is contained within the higher frequencies. With significant hearing loss in the high frequencies, important speech information is often inaudible or unusable. Other interfering sounds such as background noise, competing voices, or room reverberation



may reduce even further the hearing-impaired listener's receptive communication ability. The presence of tinnitus may be an additional debilitating condition.

NIHL may interfere with daily life, especially those social activities that occur in noisy settings. Increased effort is required for understanding speech in these situations, which leads to fatigue, anxiety, and stress. Decreased participation in these activities often results, affecting not only hearing-impaired individuals but also friends and family members. Hearing loss is associated with depression in the elderly and may be related to dementia and cognitive dysfunction. Systematic study of the effects of hearing loss on the quality of life have only lately focused specifically on individuals with NIHL; therefore, continued studies of this kind are desirable.

The impairment in hearing ability resulting from NIHL may vary from mild to severe. An individual's ability to communicate and function in daily life varies with the degree of loss and the individual's communication needs although these relationships are complex. The magnitude of the effect on communication ability may be estimated by a variety of scales, which are often used in disability determinations. These scales, which vary substantially in the frequencies used, the upper and lower limits of impairment, age correction, and adjustment for asymmetric hearing loss, attempt to predict the degree of communication impairment (understanding of speech) on the basis of pure-tone thresholds. There is no consensus about the validity or utility of the scales, which scale should be used, whether measures of speech understanding should be included, or whether self-assessment ratings should be incorporated into either impairment rating scales or disability determinations.

## WHAT SOUNDS CAN DAMAGE HEARING?

Some sounds are so weak physically that they are not heard. Some sounds are audible but do not have any temporary or permanent after-effects. Some sounds are strong enough to produce a temporary hearing loss from which there may appear to be complete recovery. Damaging sounds are those that are sufficiently strong, sufficiently long-lasting, and involve appropriate frequencies so that permanent hearing loss will ensue.

Most of the sounds in the environment that produce such permanent effects occur over a very long time (for example, about 8 hours per workday over a period of 10 or more years). On the other hand, there are some particularly abrupt or explosive sounds that can cause damage even with a single exposure.

The line between these categories of sounds cannot be stated simply because not all persons respond to sound in the same manner. Thus, if a sound of given frequency bandwidth, level, and duration is considered hazardous, one must specify for what proportion of the population it will be hazardous and, within that proportion, by what criterion of damage (whether anatomical, audiometric, speech understanding) it is hazardous.

The most widely used measure of a sound's strength or amplitude is called "sound level," measured by a sound-level meter in units called "decibels" (dB). For example, the sound level of speech at typical conversational distances is between 65 and 70 dB. There are weaker sounds, still audible, and of course much stronger sounds. Those above 85 dB are potentially hazardous.

Sounds must also be specified in terms of frequency or bandwidth, roughly like the span of keys on a piano. The range of audible frequencies extends from about 20 Hz, below the lowest notes on a piano, to at least 16,000 or 20,000 Hz, well above the highest notes on a piccolo. Most environmental noises include a wide band of frequencies and, by convention, are measured through the "A" filter in the sound-level meter and thus are designated in dB(A) units. It is not clear what effect, if any, sound outside the frequency range covered in dB(A) measurements may have on hearing. At this time, it is not known whether ultrasonic vibration will damage hearing.

To define what sounds can damage hearing, sound level, whether across all frequency bands or taken band by band, is not enough. The duration of exposure—typical for a day and accumulated over many years—is critical. Sound levels associated with particular sources such as snowmobiles, rock music, and chain saws, are often cited, but predicting the likelihood of NIHL from such sources also requires knowledge of typical durations and the number of exposures.

There appears to be reasonable agreement that sound levels below 75 dB(A) will not engender a permanent hearing loss, even at 4000 Hz. At higher levels, the amount of hearing loss is directly related to sound level for comparable durations.

According to some existing rules and regulations, a noise level of 85 dB(A) for an 8-hour daily exposure is potentially damaging. If total sound energy were the important predictor, an equivalent exposure could be as high as 88 dB(A) if restricted to 4 hours. (A 3-dB increase is equivalent to doubling the sound intensity.) This relation, enshrined in some standards and regulations, is a theory based on a dose or exposure defined by total energy.

In spite of the physical simplicity of a total-energy concept, other principles have been invoked to define equivalent exposures of different sound levels and durations. Early research suggested that NIHL after 10 years could be predicted from temporary threshold shifts (TTS) measured 2 minutes after a comparable single-day exposure. Those results, however, were taken to indicate that a halving of duration could be offset by a 5-dB change in sound level rather than a 3-dB change. This 5-dB rule is implemented in the Walsh-Healey Act of 1969 and subsequent Occupational Safety and Health Administration regulations for the purpose of requiring preventive efforts for noise-exposed workers. The 3-dB trading rule is agreed to in International Standards Organization (ISO) Standard 1999.2 (1989) for the purpose of predicting the amount of noise-induced hearing loss resulting from different exposures. There is no consensus concerning a single rule to be used for all purposes in the United States.

Generally, for sound levels below about 140 dB, different temporal forms of sound, whether impulse (gunshot), impact (drop forge) or steady state (turbine), when specified with respect to their level and duration, produce the same hearing

loss. This does not appear to follow at levels above 140 dB, where impulse noise creates more damage than would be predicted. This may imply that impulse noise above a certain critical level results in acoustic trauma from which the ear cannot recover.

Although sound exposures that are potentially hazardous to hearing are usually defined in terms of sound level, frequency bandwidths, and duration, there are several simple approximations that indicate that a sound exposure may be suspected as hazardous. These include the following: If the sound is appreciably louder than conversational level, it is potentially harmful, provided that the sound is present for a sufficient period of time. Hazardous noise may also be suspected if the listener experiences: (a) difficulty in communication while in the sound, (b) ringing in the ear (tinnitus) after exposure to the sound, and/or (c) the experience that sounds seem muffled after leaving the sound-exposure area.

In the consideration of sounds that can damage hearing, one point is clear: it is the acoustic energy of the sound reaching the ear, not its source, which is important. That is, it does not matter if the hazardous sound is generated by a machine in the workplace, by an amplifier/loudspeaker at a rock concert, or by a snowmobile ridden by the listener. Significant amounts of acoustic energy reaching the ear will create damage—at work, at school, at home, or during leisure activities. Although there has been a tendency to concentrate on the more significant occupational and transportation noise, the same rules apply to all potential noise hazards.

## **WHAT FACTORS, INCLUDING AGE, DETERMINE AN INDIVIDUAL'S SUSCEPTIBILITY TO NOISE-INDUCED HEARING LOSS?**

One thoroughly established characteristic of NIHL is that, on the average, more intense and longer-duration noise exposures cause more severe hearing loss. A second is that there is a remarkably broad range of individual differences in sensitivity to any given noise exposure. Several factors have been proposed to explain differences in NIHL among individuals; others may be associated with differences over time within the same individual. It is important to distinguish those factors whose roles in determining susceptibility are supported by a consistent body of theory and empirical evidence from other factors whose roles have been proposed but for which theory, data, or both are less conclusive.

### **Differences Among Individuals**

Both temporary threshold shift (TTS) and permanent threshold shift (PTS) in response to a given intense noise may differ as much as 30 to 50 dB among individuals. Both animal research and retrospective studies of humans exposed to industrial noise have demonstrated this remarkable variation in susceptibility. The biological bases for these differences are unknown. A number of extrinsic factors (e.g., characteristics of the ear canal and middle ear, drugs, and prior exposure to noise) may influence an individual's susceptibility to NIHL. However, animal studies that have controlled these variables suggest that individual differences in inner ear anatomy and physiology also may be significant. Additional research is necessary to determine whether vascular, neural feedback (efferent system), or other mechanisms can account for and predict such individual variation.

One factor that may be associated with decreased susceptibility to NIHL is conductive hearing loss; the cochlear structures may be protected by any form of acoustic attenuation. For similar reasons, middle ear muscles, which normally serve a protective function by contracting in response to intense sound, when inoperative, can result in increased susceptibility. Among the other factors that are *theoretically* associated with differences in susceptibility are (a) unusually efficient acoustic transfer through the external and middle ear, as a determinant of the amount of energy coupled to the inner ear structures,

and (b) preexisting hearing loss, which could imply that less additional loss would occur if the sensitive structures have already been damaged. Support for these hypotheses has been modest, in the case of the transfer function, because little empirical work has been done to test that hypothesis, and, in the case of reduced sensitivity, because several studies disagree. In general, when there is a difference in average loss to a given noise exposure, those ears with previous PTS or TTS have shown somewhat less additional loss than those not previously exposed.

Findings have sometimes implicated degree of pigmentation, both of the receptor structures (melanization) and of the eye and skin, as related to susceptibility. However, these results, too, are equivocal.

**Gender.** There is little difference in hearing thresholds between young male and female children. Between ages 10 and 20, males begin to show reduced high-frequency auditory sensitivity relative to females. Women continue to demonstrate better hearing than men into advanced age. These gender differences are probably due to greater exposure of males to noise rather than to their inherent susceptibility to its effects.

### **Differences Within Individuals**

**Ototoxic drugs.** Among the causes of differences of susceptibility to noise exposure *within* individuals are ototoxic drugs and other chemicals. In animal research, certain antibiotics (aminoglycosides) appear to exacerbate the damaging effects of noise exposure. Clinical evidence of corresponding effects in human patients has not been established, but precautions should be taken with regard to noise exposures of individual patients treated with these medications. Although high doses of aspirin are widely known to cause TTS and tinnitus, aspirin has *not* been shown to increase susceptibility to NIHL.

**Age.** In certain animal models there is evidence of heightened susceptibility to noise exposure shortly after birth—a “critical period” (possibly following the time when fluids fill the middle ear but before complete development of the cochlear structures). However, it is *not* clear that data from such animal models can be generalized to full-term normal human infants. Premature infants in noisy environments (e.g. neonatal intensive care units), however, may be at risk.

At the other extreme, increasing age has been hypothesized to be associated with decreasing susceptibility. This contention is based on the existence of presbycusis, hearing loss that increases with age and that is *not* known to be attributable to excessive noise exposure or other known etiology. The typical levels of presbycusis at various ages have recently been incorporated as Annex A in International Standards Organization Standard 1999.2 (1989). That standard may be used to estimate the portion of overall hearing loss that is attributable to exposure to excessive noise.

In summary, scientific knowledge is currently inadequate to predict that any individual will be safe in noise that exceeds established damage-risk criteria, nor that specific individuals will show greater-than-average loss following a given exposure. Among the many proposed explanations, the hypothesis that the resonant and transmission properties of the external and middle ear affect individual susceptibility deserves further attention. Empirical support for this hypothesis should not be difficult to obtain, but very few data have been collected on this question, both for TTS (experimentally) and PTS (retrospectively). Differences in susceptibility of the cochlear structures to NIHL may exist, but no practical approach to predicting them is yet available. Identification of susceptible humans will almost certainly be delayed until a successful animal model is available.

## **WHAT CAN BE DONE TO PREVENT NOISE-INDUCED HEARING LOSS?**

Noise-induced hearing loss occurs every day—in both occupational and nonoccupational settings. The crucial questions for prevention are as follows: (1) What can individuals do to protect themselves from NIHL? (2) What role should others, such as educators, employers, or the Government, play in preventing NIHL? (3) What general strategies should be employed to prevent NIHL? Answers to these questions have long been known, but solutions have not been effectively implemented in many cases. As a result, many people have needlessly suffered hearing loss.

### **Individual Protection Strategies**

Hearing conservation must begin by providing each individual with basic information. NIHL is insidious, permanent, and irreparable, causing communication interference that can substantially affect the quality of life. Ringing in the ears and muffling of sounds after sound exposure are indicators of potential hazard. Dangerous sound exposures can cause significant damage without pain, and hearing aids do not restore normal hearing. Individuals should become aware of loud noise situations and avoid them if possible or properly use hearing protection. It is important to recognize that both the level of the noise and its duration (i.e., exposure) contribute to the overall risk. Certain noises, such as explosions, may cause immediate permanent damage.

Many sources, such as guns, power tools, chain saws, small airplanes, farm vehicles, firecrackers, some types of toys, and some medical and dental instruments may produce dangerous exposures. Music concerts, car and motorcycle races, and other spectator events often produce sound levels that warrant hearing protection. Similarly, some stereo headphones and loudspeakers are capable of producing hazardous exposures. Parents should exercise special care in supervising the use of personal headset listening devices, and adults and children alike should learn to operate them at safe volume settings.

### **Nonoccupational Strategies**

Hearing loss from nonoccupational noise is common, but public awareness of the hazard is low. Educational programs should be targeted toward children, parents, hobby groups,



public role models, and professionals in influential positions such as teachers, physicians, audiologists and other health care professionals, engineers, architects, and legislators. In particular, primary health care physicians and educators who deal with young people should be targeted through their professional organizations. Consumers need guidance and product noise labeling to assist them in purchasing quieter devices and in implementing exposure reduction strategies. The public should be made aware of the availability of affordable, effective hearing protectors (ear plugs, ear muffs, and canal caps). Hearing protection manufacturers should supply comprehensive instructions concerning proper protector use and also be encouraged to increase device availability to the public sector. Newborn nurseries, including neonatal intensive care units, should be made quieter. Medical and dental personnel should be trained to educate their patients about NIHL.

Individuals with significant noise exposure need counseling. Basic audiometric evaluations should be widely available. The goal is to detect early noise-induced damage and interrupt its progression *before* hearing thresholds exceed the normal range.

### **Occupational Strategies**

Hearing conservation programs for occupational settings must include the following interactive components: sound surveys to assess the degree of hazardous noise exposure, engineering and administrative noise controls to reduce exposures, education to inform at-risk individuals why and how to prevent hearing loss, hearing protection devices (earplugs, earmuffs, and canal caps) to reduce the sound reaching the ear, and audiometric evaluations to detect hearing changes. Governmental regulations that currently apply to most noisy industries should be revised to encompass *all* industries and all employees, strengthened in certain requirements, and strictly enforced with more inspections and more severe penalties for violations.

Many existing hearing conservation programs remain ineffective due to poor organization and inadequately trained program staff. Senior management must use available noise controls, purchase quieter equipment, and incorporate noise reduction in planning new facilities. Noise exposures must be measured accurately and the degree of hazard communicated

to employees. Hearing protection devices must be available that are comfortable, practical for the demands of work tasks, and provide adequate attenuation. Labeled ratings of hearing protector attenuation must be more realistic so that the degree of protection achieved in the workplace can be properly estimated. Each employee must be individually fitted with protectors and trained in their correct use and care. Employees need feedback about their audiometric monitoring results annually.

Employers need to monitor program effectiveness by using appropriate techniques for analysis of group audiometric data. By detecting problem areas, managers can prioritize resource allocations and modify company policies to achieve effectiveness. Potential benefits include reduced costs for worker's compensation, enhanced worker morale, reduced absenteeism, fewer accidents, and greater productivity.

Enactment of uniform regulations for awarding worker's compensation for occupational hearing loss would stimulate employers' interest in achieving effective hearing conservation programs. Equitable criteria for compensability should be developed based on scientific investigations of the difficulties in communication and other aspects of auditory function encountered in everyday life by persons with differing degrees of NIHL.

### **General Strategies**

Both nonoccupational and occupational NIHL could be reduced by implementing broader preventive efforts. Labeling of consumer product noise emission levels should be enforced according to existing regulations. Incentives for manufacturers to design quieter industrial equipment and consumer goods are needed along with regulations governing the maximum emission levels of certain consumer products, such as power tools. Reestablishment of a Federal agency coordinating committee with central responsibility for practical solutions to noise issues is essential. Model community ordinances could promote local planning to control environmental noise and, where feasible, noise levels at certain spectator events. High-visibility media campaigns are needed to develop public awareness of the effects of noise on hearing and the means for self-protection. Prevention of NIHL should be part of the health curricula in elementary through high schools. Self-education materials for adults should be readily available.

## WHAT ARE THE DIRECTIONS FOR FUTURE RESEARCH?

The panel recommends that research be undertaken in two broad categories: (1) Studies that use existing knowledge to prevent NIHL in the immediate future, and; (2) research on basic mechanisms to prevent NIHL in the long-term future.

- Development of rationale and collection of empirical data to evaluate systems for combining sound level and duration to predict NIHL.
- Longitudinal studies to further delineate responses of the ear to noise over time in different groups of people with varying levels of exposure.
- Continued investigation of engineering noise measurement and control techniques, such as acoustic intensity measurement, active noise-cancellation systems, and cost-benefit analyses of noise reduction.
- Development and investigation of hearing protector designs that provide improved wearer comfort, usability, and more natural audition.
- Development of repeatable laboratory procedures that incorporate behavioral tests to yield realistic estimates of hearing protector attenuation performance that are accepted for device labeling purposes.
- Empirical evaluation of the efficacy of hearing conservation programs and the field performance of hearing protection devices in industry.
- Development and validation of evaluation techniques for detection of the following:
  - (a) subtle changes in hearing resulting from noise exposure and
  - (b) early indicators of NIHL.
- Determination of the pathophysiological correlates of TTS and PTS.
- Investigation of the anatomic and physiologic bases of presbycusis and interactive effects with NIHL.
- Investigation of genetic bases for susceptibility to NIHL, using contemporary techniques, including molecular biology.
- Further studies of drugs (e.g., vasodilating agents) and other pre-exposure conditions (e.g., activation of efferent systems or exposure to "conditioning" noise) that have been suggested in preliminary reports to protect the inner ear from NIHL and elucidation of the underlying mechanisms.
- Investigation into the physiologic mechanisms underlying the synergistic effects of certain drugs and noise exposure in animal models.

## CONCLUSIONS AND RECOMMENDATIONS

- Sounds of sufficient intensity and duration will damage the ear and result in temporary or permanent hearing loss at any age.
- NIHL is characterized by specific anatomic and physiologic changes in the inner ear.
- Sounds with levels less than 75 dB(A), even after long exposures, are unlikely to cause permanent hearing loss.
- Sounds with levels above 85 dB(A) with exposures of 8 hours per day will produce permanent hearing loss after many years.
- There is a broad range of individual differences among people in the amount of hearing loss each suffers as a result of identical exposures.
- Current scientific knowledge is inadequate to predict that any particular individual will be safe when exposed to a hazardous noise.
- Because sources of potentially hazardous sound are present in both occupational and nonoccupational settings, personal hearing protection should be used when hazardous exposures are unavoidable.
- Vigorous enforcement of existing regulations, particularly for the workplace and consumer product labeling, would significantly reduce the risk of workplace NIHL. Regulations should be broadened to encompass all employees with hazardous noise exposures.
- Application of existing technologies for source noise control, especially in the manufacture of new equipment and construction of new facilities, would significantly reduce sound levels at the ear.
- In addition to existing hearing conservation programs, a comprehensive program of education regarding the causes and prevention of NIHL should be developed and disseminated, with specific attention directed toward educating school-age children.

## **Consensus Development Panel**

### **Patrick E. Brookhouser, M.D.**

Conference and Panel  
Chairperson

*Director*

Boys Town National Research  
Hospital

*Professor and Chair*

Department of Otolaryngology  
Creighton University  
Omaha, Nebraska

### **John Gordon Casali, Ph.D.**

*Director*

Auditory Systems Laboratory  
Department of Industrial  
Engineering and Operations  
Research

Virginia Polytechnic Institute and  
State University  
Blacksburg, Virginia

### **Francis I. Catlin, M.D., Sc.D.**

*Professor*

Department of Otolaryngology  
and Communicative Sciences  
Baylor College of Medicine  
Houston, Texas

### **Marilyn E. Demorest, Ph.D.**

*Professor*

Department of Psychology  
University of Maryland Baltimore  
County  
Catonsville, Maryland

### **Judy R. Dubno, Ph.D.**

*Associate Professor of Surgery*  
Division of Head and Neck  
Surgery

University of California at Los  
Angeles School of Medicine  
Los Angeles, California

### **George A. Gates, M.D.**

*Professor and Vice Chairman*  
Department of Otolaryngology  
Washington University  
St. Louis, Missouri

### **Ira J. Hirsh, Ph.D.**

*Professor*

Department of Psychology  
Washington University

Director of Research Emeritus  
Central Institute for the Deaf  
St. Louis, Missouri

### **Patricia A. Leake, Ph.D.**

*Associate Professor in  
Residence*

Department of Otolaryngology  
Coleman-Epstein Laboratories  
University of California  
San Francisco, California

### **Kevin John Murphy, M.D., F.A.A.P.**

*Assistant Professor of Clinical  
Pediatrics*

Washington University Medical  
School/Northwest Pediatrics  
Florissant, Missouri

### **Julia Doswell Royster, Ph.D.**

*President*

Environmental Noise Consult-  
ants, Inc.  
Cary, North Carolina

### **Evelyn O. Talbott, Dr.P.H.**

*Assistant Professor of Epidemi-  
ology*

Department of Epidemiology  
University of Pittsburgh Gradu-  
ate School of Public Health  
Pittsburgh, Pennsylvania

### **Bonnie Tucker, J.D.**

*Attorney/Professor of Law*  
Arizona State University College  
of Law  
Tempe, Arizona

### **Charles S. Watson, Ph.D.**

*Professor and Chair*  
Department of Speech and  
Hearing Sciences  
Speech and Hearing Center  
Indiana University  
Bloomington, Indiana

### **Laura Ann Wilber, Ph.D.**

*Professor*

Department of Audiology and  
Hearing Impairment  
Northwestern University  
Evanston, Illinois

## Speakers

**Peter W. Alberti, Ph.D., M.B.**

"Clinical Criteria: Noise or Not?"

**Alf Axelsson, M.D., Ph.D.**

"Noise Exposure in Adolescents and Young Adults"

**Elliott H. Berger, M.S.**

"Hearing Protection—the State of the Art (Circa 1990) and Research Priorities for the Coming Decade"

**Barbara A. Bohne, Ph.D.**

"Patterns of Cellular Degeneration in the Inner Ear Following Excessive Exposure to Noise"

**William W. Clark, Ph.D.**

"Noise Exposure and Hearing Loss From Leisure Activities"

**Robert A. Dobie, M.D.**

"Effects of Noise-Induced Hearing Loss on Quality of Life"

**Mary Florentine, Ph.D.**

"Prevention Strategies: Education"

**Kenneth J. Gerhardt, Ph.D.**

"Prenatal and Perinatal Risks"

**Donald Henderson, Ph.D.**

"Acoustic Parameters of Hazardous Noise Exposures"

**Larry E. Humes, Ph.D.**

"Individual Susceptibility—Nonauditory Factors"

**M. Charles Liberman, Ph.D.**

"Biological Bases of Acoustic Injury"

**John H. Mills, Ph.D.**

"Noise and the Aging Process"

**Anna K. Nabelek, Ph.D.**

"Interactions Between Hearing Loss and the Environment"

**William Noble, Ph.D.**

"Evaluation of Disability and Handicap"

**Gerald R. Popelka, Ph.D.**

"The Effects of Certain Auditory Factors on Individual Susceptibility to Noise"

**Brenda Ryals, Ph.D.**

"Critical Periods and Acoustic Trauma"

**Richard Salvi, Ph.D.**

"Interaction Between Noise and Other Agents"

**Edgar A.G. Shaw, Ph.D.**

"The Measurement of Noise Exposure and the Assessment of Risk"

**Noral D. Stewart, Ph.D.**

"Noise Reduction to Prevent Hearing Damage—State of the Art, Implementation Problems, and Future Directions"

**Henning E. Von Gierke, Dr.Eng.**

"The Noise-Induced Hearing Loss Problem"

**W. Dixon Ward, Ph.D.**

"Impulse/Impact Vs. Continuous Noise"

## Planning Committee

**Ralph F. Naunton, M.D.**

*Planning Committee Chairperson*

Director

Extramural Program

Division of Communication

Sciences and Disorders

National Institute on Deafness

and Other Communication

Disorders

National Institutes of Health

Bethesda, Maryland

**Patrick E. Brookhouser, M.D.**

*Conference and Panel Chairperson*

Director

Boys Town National Research

Hospital

Professor and Chair

Department of Otolaryngology

Creighton University  
Omaha, Nebraska

**William W. Clark, Ph.D.**

*Director*

Graduate Program in Communication Sciences  
Central Institute for the Deaf  
St. Louis, Missouri

**Jerry M. Elliott**

*Program Analyst*

Office of Medical Applications of Research  
National Institutes of Health  
Bethesda, Maryland

**John H. Ferguson, M.D.**

*Director*

Office of Medical Applications of Research  
National Institutes of Health  
Bethesda, Maryland

**William H. Hall**

*Director of Communications*

Office of Medical Applications of Research  
National Institutes of Health  
Bethesda, Maryland

**Donald Henderson, Ph.D.**

*Professor and Chairman*

Communicative Disorders and Sciences  
State University of New York at Buffalo  
Buffalo, New York

**Karen Jackson**

*Information Coordinator*

National Institute on Deafness and Other Communication Disorders  
National Institutes of Health  
Bethesda, Maryland

**James F. Kavanagh, Ph.D.**

*Associate Director*

Center for Research for Mothers and Children  
National Institute of Child Health and Human Development  
National Institutes of Health  
Bethesda, Maryland

**William Melnick, Ph.D.**

*Professor*

Department of Otolaryngology  
University Hospital Clinics  
Ohio State University  
Columbus, Ohio

**Andrew Monjan, Ph.D., M.P.H.**

*Chief*

Neurobiology and Neuropsychology Units  
Neuroscience and Neuropsychology of Aging Program  
National Institute on Aging  
National Institutes of Health  
Bethesda, Maryland

**Lt. Col. Michael J. Moul, Ph.D.**

*Assistant Director*

Army Audiology and Speech Center  
Walter Reed Army Medical Center  
Washington, D.C.

**J. Buckminster Ranney, Ph.D.**

*Deputy Director*

Division of Communication Sciences and Disorders  
National Institute on Deafness and Other Communication Disorders  
National Institutes of Health  
Bethesda, Maryland

**Dina Rice**

*Conference Coordinator*

Prospect Associates  
Rockville, Maryland

**Alice H. Suter, Ph.D.**

*Visiting Scientist*

National Institute on Occupational Safety and Health  
Centers for Disease Control  
Cincinnati, Ohio

**Susan Wallace, M.F.A.**

*Conference Coordinator*

Prospect Associates  
Rockville, Maryland

**Conference Sponsors****National Institute on Deafness  
and Other Communication  
Disorders**

Jay Moskowitz, Ph.D.  
Acting Director

**Office of Medical Applications of  
Research**

John H. Ferguson, M.D.  
Director

**National Institute of Child Health  
and Human Development**

Duane F. Alexander, M.D.  
Director

**National Institute on Aging**

T. Franklin Williams, M.D.  
Director

**National Institute for  
Occupational Safety and Health  
of the Centers for Disease Control**

J. Donald Millar, M.D.  
Director





U.S. DEPARTMENT OF HEALTH AND  
HUMAN SERVICES  
Public Health Service  
Office of Medical Applications of Research  
Building 1, Room 260  
National Institutes of Health  
Bethesda, MD 20892

---

Official Business  
Penalty for private use \$300

177  
BULK RATE  
Postage & Fees  
PAID  
PHS/NIH/OD  
Permit No. G291